The image shows a black and white photograph of a book cover. The cover is decorated with a marbled paper pattern featuring large, swirling, concentric circular designs in various shades of gray and black. In the center of the cover is a rectangular white label with a thin black border. The label contains two lines of text in a typewriter-style font.

Robert W. Charler  
Bequest 1933.



















A

M O N O G R A P H

OF THE

BRITISH NUDIBRANCHIATE MOLLUSCA:

WITH

*Figures of all the Species.*

BY

JOSHUA ALDER AND ALBANY HANCOCK.

LONDON:

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MDCCCXLV.

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## ADVERTISEMENT.

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It is intended in the present work to give, as far as possible, a complete history of the British species of Mollusca included in the order *Nudibranchiata* of Cuvier, together with careful and detailed drawings of each. The latter are the more necessary on account of the perishable nature of these animals and the impossibility of preserving them with their proper forms and colours in museums.

From the difficulties attending their study on this account, many authors, in treating of the Mollusca, have entirely omitted the *Nudibranchiata*, and have confined themselves to a description of the testaceous Mollusca alone, thus leaving a gap in the chain of affinities inconsistent with a proper knowledge of this sub-kingdom of nature as a whole.

The authors of the present work confidently hope that they will be able, as far as the British species are concerned, to supply this deficiency, and to give such full delineations and descriptions of most of the species as may prevent any difficulty in their recognition by future observers. By the kind assistance of their friends, added to their own researches, they have been enabled to accumulate a large store of materials, but there are still several species described by other naturalists which they have not met with. As the Society to whom they are indebted for the publication of this Monograph have determined to bring it out in Parts, extending over a period of four or five years, the authors hope yet to obtain many of these species before its completion.

For the purpose, therefore, of affording an opportunity of adding drawings and descriptions of these from the living animals, it has been thought advisable to publish the species promiscuously, adopting such a plan as will allow of their being arranged systematically on the completion of the volume.

#### ADVERTISEMENT.

As the philosophical study of these animals is yet in a state of progression, and has lately received much attention from physiologists, the authors have also determined to defer their general views on the Order till near the completion of the work, so that they may be brought up to the knowledge then attained.

In the meantime they have given a Synopsis of the genera into which the British species may be divided, with a list of the species at present known. This will allow the reader at once to refer each species, as it appears, to its proper place, and to understand the characters of those genera, the detailed account of which may not appear until a subsequent part of the work. This synopsis will afterwards be superseded by a more complete systematic arrangement.

The authors have pleasure in stating that, in making out the anatomical details, they have had the able assistance of their friend Dr. DENIS EMBLETON, Lecturer on Anatomy in the Newcastle School of Medicine. The plates are accurate transcripts of their original drawings. They have been executed by Mrs. HOLMES, an accomplished artist in Lithotint, an invention of Mr. HULLMANDEL, admirably adapted for portraying the delicacy and beauty of these fragile inhabitants of the sea.

NEWCASTLE; *June* 1845.

# BRITISH NUDIBRANCHIATE MOLLUSCA.

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## SYNOPSIS.

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Sub-Kingdom. *Mollusca*.

Class. *Gasteropoda*.

Order. NUDIBRANCHIATA.

Fam. 1, DORIDIDÆ. Branchial plumes surrounding the vent on the medio-dorsal line.

Sub-Family, *Doridinæ*. With a cloak.

Gen. 1. *Doris*, Linnaeus. Tentacles clavate or conical, retractile within cavities, sometimes slightly sheathed: cloak large, covering the head and foot; without appendages.

\*Body depressed: plumes retractile within a single cavity.

*D. tuberculata*, Cuv.

*D. flammea*, A. & H.

*D. Johnstoni*, A. & H. (*D. obvelata*, Johns.)

*D. coccinea*, For.

*D. repanda*, A. & H.

*D. mera*, A. & H.

\*\*Body depressed: plumes retractile within separate cavities.

*D. Ulidiana*, Thomp.

*D. muricata*, Mull.

*D. aspera*, A. & H.

*D. bilamellata*, Linn.

*D. affinis*, Thomp.

*D. depressa*, A. & H.

\*\*\*Body convex: plumes non-retractile.

*D. pilosa*, Mull.

*D. similis*, A. & H.

*D. lævis*, Mull.

*D. sublævis*, Thomp.

Gen. 2. *Goniodoris*, Forbes. Tentacles clavate, non-retractile, without sheaths: cloak small, exposing the head and foot: without appendages.

*G. nodosa*, Mont.

vars. *G. Barvicensis*, Johns.

*G. marginata*, Mont.

*G. emarginata*, For.

*G. elongata*, Thomp.



## SYNOPSIS.

Gen. 3. *Triopa*, Johnston. Tentacles clavate, retractile within sheaths: cloak margined with filaments.

*T. clavigera*, Mull.

var. *T. plumosa*, Thomp.

Sub-Family, *Polycerinae*. Without distinct cloak.

Gen. 4. *Ægires*, Loven. Tentacles linear, retractile within sheaths: body covered with very large tubercles.

*Æ. Maura*, For.

*Æ. punctilucens*, D'Orb.

Gen. 5. *Thecacera*, Fleming. Tentacles clavate, with sheaths: head bilobed: branchiæ with two or more lateral appendages.

*T. pennigera*, Mont.

Gen. 6. *Polycera*, Cuvier. Tentacles clavate, non-retractile: without sheaths: a veil over the head bordered with tubercles or tentacular points: branchiæ with two or more lateral appendages.

*P. quadrilineata*, Mull.

var. *D. flava*, Mont.

*P. typica*, Thomp.

*P. ocellata*, A. & H.

var. *Triopa Nothus*, Johns.?

*P. Lessonii*, D'Orb. (*P. citrina*, Ald.)

Gen. 7. *Idalia*, Leuckart. Tentacles clavate or linear, with filaments at their base: head slightly lobed at the sides: back with numerous branchial appendages.

*I. elegans*, Leuck.

*I. aspersa*, A. & H.

*I. quadricornis*, Mont.

*I. cristata*, Ald.

Fam. 2. TRITONIDÆ. Branchiæ laminated, plumose, or papillose, arranged down the sides of the back: stomach simple.

Gen. 8. *Tritonia*, Cuvier. Tentacles 2, with branched filaments, retractile within sheaths: veil tuberculated or digitated: branchiæ plumose, arranged in a single series on a ridge down each side of the back.

*T. Hombergii*, Cuv.

*T. plebeia*, Johns.

var. *T. pulchra*, Johns.

Fam. 3. EOLIDIDÆ. Branchiæ papillose or branched, arranged on the sides of the back: stomach branched.

Sub-Family, *Melibæinae*. Tentacles 2, with sheaths.

Gen. 9. *Dendronotus*, Ald. & Hanc. Tentacles clavate, laminated, retractile within sheaths; front of the head with branched appendages: branchiæ branched, arranged in a single series down each side of the back.

*D. arborescens*, Mull.

var. *Tr. lactea*, Thomp.

*Tr. pulchella*, A. & H.

*D. felina*, A. & H.?

## SYNOPSIS.

Gen. 10. *Doto*, Oken. Tentacles linear, retractile within sheaths: veil small, simple: branchiæ ovate-muricate, arranged in a single series down each side of the back.

*D. fragilis*, For. (*Melibæa pinnitifida*, Johns.)

*D. coronatus*, Gm.

var. *M. ornata*, A. & H.

*D. pinnitifidus*, Mont.

*D. maculatus*, Mont.

Sub-Family, *Eolidinæ*. Tentacles without sheaths, linear, 2, 4, or none.

Gen. 11. *Eolis*, Cuvier. Tentacles 4: branchiæ papillose, arranged in rows on the sides of the back: anus lateral.

\*Branchial papillæ numerous, depressed, and imbricated.

*E. papillosa*, Linn.

*E. Zetlandica*, For.

*E. rosea*, A. & H.

*E. obtusalis*, A. & H.

*E. stipata*, A. & H.

\*\*Branchial papillæ clustered. (*Flabellina*, Cuv.)

*E. coronata*, For.

*E. Drummondi*, Thomp.

*E. curta*, A. & H.

*E. pedata*, Mont.

*E. Cuvieri*, Johns.

*E. rufibranchialis*, Johns.

*E. pellucida*, A. & H.

*E. gracilis*, A. & H.

*E. alba*, A. & H.

\*\*\*Branchial papillæ in transverse, rather distant, rows. (*Cavolina*, Brug.)

*E. angulata*, A. & H.

*E. nana*, A. & H.

*E. concinna*, A. & H.

*E. aurantiaca*, A. & H.

*E. olivacea*, A. & H.

*E. cingulata*, A. & H. (*Hystrix*, A. & H.)

*E. vittata*, A. & H.

*E. Northumbrica*, A. & H.

*E. viridis*, For.

*E. longicornis*, Mont.

*E. arenicola*, For.

*E. purpurescens*, Flem.

*E. cœrulea*, Mont.

*E. foliata*, For.

*E. pallida*, A. & H.

*E. tricolor*, For.

*E. Farrani*, A. & H.

\*\*\*\*Branchial papillæ in a single row on each side. (*Tegipes*, Cuv.)

*E. despecta*, Johns.

*E. plumosa*, Flem.

## SYNOPSIS.

Gen. 12. *Pterochilus*, Ald. & Hanc. Tentacles 2, simple; head with lateral lobes: branchiæ papillose, arranged down the sides of the back: anus lateral.

P. pulcher, A. & H.

P. minimus, For.

Gen. 13. *Hermæa*, Loven. Tentacles 2, longitudinally folded: head without lobes: branchiæ papillose, arranged down the sides of the back: anus dorsal or sublateral.

H. bifida, Mont.

H. dendritica, A. & H.

Gen. 14. *Alderia*, Allman, M. S. Without tentacles: head lobed at the sides: branchiæ papillose, arranged down the sides of the back: anus dorsal.

A. modesta, Loven.

Gen. 15. *Proctonotus*, Ald. & Hanc. Tentacles 4: a veil over the head: branchiæ papillose, arranged on a ridge down the sides of the back and round the head in front: anus dorsal.

P. mucroniferus, A. & H.



## PREFACE.

A MUCH longer time has elapsed in the publication of this Monograph than was originally anticipated. When the first Part was issued, ten years ago, the study of the Nudibranchiate Mollusca was comparatively in its infancy, and the extent to which the work might reach was, therefore, pretty much a matter of conjecture. Few branches of science have advanced more rapidly than this has done during the period. New views have opened up, and materials have accumulated in our hands to such an extent that it has been found impossible to keep the work within the limits originally prescribed. Should, therefore, any want of unity be detected in its execution, it must be attributed to this cause. Some repetitions have been found unavoidable, arising partly from the irregular mode of its issue, and partly from the desire to give the information we possessed while it was yet new. Our opinions, too, have occasionally undergone a little modification as the work advanced.\* We trust, however, that the disadvantages arising from these causes will not be found of any great importance, and that the increased information we are enabled to give will be thought a sufficient compensation for the delay.

The valuable assistance we have received from our friends during the progress of the work claims our most grateful thanks. Every new species found by other naturalists has been unreservedly communicated to us as it occurred, and manuscripts, drawings, and specimens relating to them, or illustrating species already published, have been liberally placed in our hands. For assistance of this kind we are especially indebted to our late lamented friends, Professor Edward Forbes, and William Thompson, Esq., of Belfast. To the Rev. Dr. Fleming our thanks are due for the like assistance. Nor should we omit to mention the instruction we have gained from the specimens and drawings of Scandinavian species intrusted to us for examination by Professor Lovén, of Stockholm; and the numerous fine

\* To account for any discrepancy that may thus occur, we have given a list of the contents of each Part, with the dates of their publication.

## PREFACE.

examples of Mediterranean Nudibranchs sent us by Professor Verany, of Nice. Along with many other favours, we owe to our valued and lamented friend, Dr. Johnston, of Berwick, the kind encouragement which first induced us to undertake this work, the completion of which, alas! he has not lived to witness.

To mention all to whom we are under obligations would be to enumerate nearly every living naturalist who has paid attention to the subject. The assistance we have received from each is, we trust, duly acknowledged in its proper place. We may, however, be allowed to particularise here the names of Professor Allman, of Dublin; Mr. Cocks, of Falmouth; Dr. Gray, of the British Museum; Mr. Price, of Birkenhead; the Rev. David Landsborough, junr., of Kilmarnock; Mr. Barlee, of Exmouth; and Mr. George Murray, of Burghead. To our friend, Dr. Embleton, our thanks are especially due for the assistance he has given us in the necessary anatomical investigations. With the advantage of his assistance, we feel greater confidence in the result of our labours in this department than we should otherwise have done.

In nothing has the lapse of time since the commencement of our task been more forcibly impressed upon us than in the losses we have sustained by the hand of death during its progress. Not only have we to lament the untimely decease of the three eminent naturalists, Dr. Johnston, Professor Edward Forbes, and Mr. Thompson of Belfast, who were appointed a sub-committee of the Ray Society, to see this work through the press, and who took a friendly interest in its progress; but two of the artists who have successively been employed in it—Mrs. Holmes, who undertook the lithotinting of the earlier parts, and Mr. Wing, who succeeded her with equal ability—are now also numbered with the dead. The later plates have been executed by Mr. Ford, of the firm of Ford and West, in a manner that has met with our entire approbation. The style has been changed from lithotint to lithography, we think with advantage; as the latter, in the hands of a competent artist, possesses the advantage of greater certainty in the execution than can be attained by the former method.

NEWCASTLE-UPON-TYNE,  
*Sept.* 1855.

CONTENTS OF THE PARTS AS ISSUED, WITH THEIR DATES OF  
PUBLICATION.

---

Part 1.—1845, for 1844.

Advertisement.

First or provisional Synopsis

- Fam. 1, Pl. 4. *Doris flammea*.  
5. *Johnstoni*.  
26. *Idalia aspera*.  
Fam. 3, Pl. 3. *Dendronotus arborescens*.  
21. *Eolis alba*.  
24. *concinna*.  
26. *olivacea*.  
34. *tricolor*.  
35. *Farrani*.  
36. *despecta*.

Part 2.—1846, for 1845.

- Fam. 1, Pl. 10. *Doris diaphana*.  
13. *pusilla*.  
18. *Goniodoris nodosa*.  
23. *Polycera ocellata*.  
Fam. 3, Pl. 1. Larvæ of the Eolididæ.  
2. Genus 11. *Dendronotus*.  
4. Genus 12. *Doto*.  
6. *Doto coronata*.  
12. *Eolis coronata*.  
15. *punctata*.  
23. *angulata*.  
30. *amœna*.  
42. *Proctonotus mucroniferus*.



## CONTENTS.

### Part 3.—1847, for 1846.

- Fam. 1, Pl. 6. *Doris repanda*.  
           8.       *planata*.  
           19. *Goniodoris castanea*.  
           25. *Ancula cristata*.  
 Fam. 2, Pl. 3. *Tritonia plebeia*.  
 Fam. 3, Pl. 1 *a*. *Lomanotus (Eumenis) marmorata*.  
           7 and 8. Genus 13. *Eolis*.  
           19. *Eolis pellucida*.  
           28.       *cingulata*.  
           31. {       *arenicola*.  
               {       *Northumbrica*.  
           33.       *picta*.

### Part 4.—1848.

- Fam. 1, Pl. 7. *Doris coccinea*.  
           14.       *sparsa*.  
           20. *Triopa claviger*.  
           21. *Ægirus punctilucens*.  
           24. *Polycera Lessonii*.  
 Fam. 2, Pl. 5. Genus 9 *bis*. *Scyllæa*.  
 Fam. 3.       Genus 10. *Lomanotus (Eumenis)*.  
           Pl. 11. *Eolis glauca*.  
               13.       *Drummondi*.  
               14.       *rufibranchialis*.  
               20.       *Landsburgii*.  
               25.       *nana*.  
               40. *Hermæa dendritica*.

### Part 5.—1851.

- Fam. 1, Pl. 1 and 2. Genus 1. *Doris*.  
           12. { *Doris depressa*.  
               {   *inconspicua*.  
           15.       *pilosa*.  
           16. {       *subquadrata*.  
               {       *oblonga*.  
           22. *Polycera quadrilineata*.  
 Fam. 2, Pl. 4. *Tritonia lineata*.  
 Fam. 3, Pl. 5. *Doto fragilis*.  
           16. *Eolis lineata*.  
           17. {       *smaragdina*.  
               {       *elegans*.  
           27.       *aurantiaca*.  
           37.       *exigua*.

## CONTENTS.

- Genus 14. Embletonia.
- Fam. 3, Pl. 38. Embletonia pulchra.
- Genus 16. Hermæa.
39. Hermæa bifida.
- Genus 17. Alderia.
- Genus 18. Proctonotus.
43. Genus 10. Antiopa.

### Part 6.—1854, for 1852.

- Fam. 1, Pl. 3. Doris tuberculata.
9. { aspera.
- proxima.
11. bilamellata.
- Fam. 3, Pl. 9. Eolis papillosa.
10. { Peachii.
- Alderi.
18. gracilis.
22. { Glaucoides.
- stipata.
29. { vittata.
- Glottensis.
32. viridis.
41. { Alderia modesta.
- Lomanotus flavidus.
44. { Antiopa cristata.
- hyalina.
- Fam. 1, Pl. 17. Genus 2. Goniodoris.
- Genus 3. Triopa.
- Genus 4. Ægirus.
- Genus 5. Thecacera.
- Genus 6. Polycera.
- Genus 7. Ancula.
- Genus 8. Idalia.

### Part 7.—1855.

- Preface.
- General history.
- Synopsis.
- Fam. 1, Pl. 21 a. Thecacera pennigera.
27. { Idalia elegans.
- Leachii.
- Fam. 2, Pl. 1. Genus 9. Tritonia.
2. Tritonia Hombergii.
- Genus 15. Fiona.
- Fam. 3, Pl. 38 a. Fiona nobilis.

## CONTENTS.

Pl. 45, Supplementary. { Doto pinnatifida.  
                                  { Eolis pustulata.  
                                  { Parasites.

46, Sup. Tongues of the Dorididæ.

47, Sup. Tongues of the Eolididæ.

48, Sup. Spicula of the Dorididæ.

Appendix.

List of Works referred to.

List of Plates.

Index.

Contents of parts.

A MONOGRAPH

OF THE

BRITISH NUDIBRANCHIATE MOLLUSCA.

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THE Mollusks whose history and characters it is the purpose of the present work to illustrate, form an attractive group of the class GASTEROPODA, until lately little noticed, and supposed to be of small extent, but which modern researches have brought into more prominent importance.

As here treated of, the order NUDIBRANCHIATA is restricted to those animals bearing the character assigned to it by Cuvier; namely, the possession of distinct external and uncovered gills. This group forms the family *Tritoniens* of Lamarck. Blainville has made of it two orders,—*Polybranchiata* and *Cyclobranchiata*; and in the more recent arrangement of Milne Edwards, it constitutes a family of his *Opistobranchiata*.

The Nudibranchiate Mollusca are all marine, and, with the exception of a few species, are of small size. To some they are known by the familiar name of sea-slugs; a name, however, not exclusively applied to them, as it is given to several other naked mollusks, which, like them, have a resemblance to the land slugs in the general form of their body. The term, as applied to these animals, is far from complimentary. The land slugs are generally sombre in colour, and plain and uninviting in form, while these little inhabitants of the deep are often adorned with the most brilliant colours, and of forms the most varied and graceful.

Their body is usually elongated, soft, and attached through its whole length to the foot or disc upon which they crawl. It is not unfrequently covered with a cloak, and in the family *Dorididæ* the skin is strengthened with calcareous spicula.

The head is anterior, and frequently indistinct, bearing one or two pairs of tentacles, the upper pair of which are placed on the cloak when it is present, and behind them the eyes are

situated. But the characteristic peculiarity of these mollusks is the appendages that constitute their breathing organs, placed upon the back, always symmetrically, in plumes, tufts, or papillæ, either forming a circle on the central line, or arranged in rows upon the sides.

Unfortunately, the *Nudibranchiata* are as perishable as they are beautiful, it being impossible to preserve them after death in their original forms and colours. From this circumstance it is that they are so little known to the generality of persons, and that specimens are seldom to be found in museums. The shapeless and colourless mass which most of them present when preserved in spirits, is, indeed, a very poor representation of the living animal: yet even in this state, imperfect as it is, they are useful for the examination of the zoologist, as the characters may generally be observed by which the species are distinguished; not to mention the value of such specimens for the purpose of dissection. It is much to be regretted, therefore, that these animals are not more frequently preserved, and that scientific travellers of our own nation have so seldom paid attention to the foreign species, either by preserving specimens for examination, or by making drawings of the living animals on the spot; both of which are necessary for a proper knowledge of the genera and species.

None of the Nudibranchiate Mollusca appear to have been known to the ancients, and even up to the time of Linnæus, they remained, with one or two rare exceptions, entirely unnoticed. In the 12th edition of his 'Systema Naturæ,' only seven species were described, scarcely any of which had come under his own observation in a living state. They were placed by him in the class *Vermes*, and referred to the genera *Doris*, *Scyllæa*, and *Tethys*. That excellent observer, Otho Frederic Müller, paid more attention to them: twelve species are characterised in his 'Zoologiæ Danicæ Prodrômus,' most of which were afterwards figured with fuller descriptions in the 'Zoologia Danica.' The number of species introduced into the latter work is fourteen. Otho Fabricius has also excellent descriptions of two or three of these mollusks in his 'Fauna Grœnlandica.' Other authors contributed a little to increase the number of species, among whom Bommé, who described several in the Flushing Transactions, is deserving of honorable mention. But these sparing contributions—few and far between—were not sufficient to attract the general attention of naturalists to a group of animals difficult of observation, and whose physiology and habits were as yet entirely unknown. It was not until the appearance of the celebrated 'Mémoires' of Cuvier, in the 'Annales du Muséum,' that much attention was drawn to this subject. These formed a new era in their history, and the dissections there given furnished the groundwork for those more correct views of their affinities which that distinguished naturalist carried out in the 'Règne Animal,' where the order *Nudibranchiata* was first instituted for their reception. Even at that time, however, very few species were known, and it is to be regretted that Cuvier was obliged to have recourse to specimens preserved in spirits for his descriptions. So far as their anatomy was concerned, this disadvantage was not greatly felt, but the figures and descriptions of their external forms were in consequence very imperfect. The position of this group in relation to the testaceous tribes, from which they had been kept apart in the Linnean arrangement, began now to be generally acknowledged. Their affinities were further illustrated in the celebrated 'Histoire Naturelle des Animaux sans Vertèbres,' of Lamarck, and in the 'Manuel de Malacologie' of Blainville; each of which contributed something to the knowledge of their physiology and relations, but not much to the number of species.

Let us now see what had been done during this time by the naturalists of our own



country. Stanch disciples of the Linnean school, the British naturalists had applied themselves to the study of species with much more alacrity than their more speculative brethren of the Continent, and the Fauna of the British Islands had in consequence assumed a more full and comprehensive form. One is disappointed, therefore, to find how very little was until lately known of the Nudibranchiate Mollusca of our own shores. The 'British Zoology' of Pennant, published in 1777, contains just three species, which he calls *Doris Argo*, *Doris verrucosa*, and *Doris electrica*; the two former are common and conspicuous animals that could scarcely be overlooked by a collector; the latter is so imperfectly described that it cannot now be identified. For more than twenty years after the publication of Pennant's work, no further notice was taken of this neglected tribe. In 1802, however, Montagu published in the 'Linnean Transactions' the first of his series of papers on the marine animals of the Devonshire Coast. In these excellent papers twelve species of Nudibranchiate Mollusca were described, all new to Britain, and, with the exception of two or perhaps three species, then unknown to naturalists. They were all referred to the genus *Doris*, which at that time was the general receptacle for most of the species of the order. In such veneration, indeed, was the arrangement of the great Swedish naturalist then held by English authors, that even his genera were considered sacred from the hand of innovation, and each new form, however incongruous, was referred to some known Linnean genus. Montagu, however, was too accurate a student of nature to avoid seeing the necessity of some change, and in one of his later papers we find him proposing to admit the genus *Tritonia* of Bosc, for a part of the Dorides, but still, in deference to the naturalists of the Linnean school, he does not venture at once on such an innovation but reserves it for further consideration.\* The species described by him are;—*Doris pinnatifida*, *D. cærulea*, *D. flava*, *D. marginata*, *D. maculata*, *D. longicornis*, *D. nodosa*, *D. papillosa*, *D. quadricornis*, *D. pennigera*, *D. pedata*, and *D. bifida*, none of which now belong to the restricted genus *Doris*, but are distributed into seven different genera. Unfortunately, several of them have not since been met with. We have used every exertion to ascertain the species described by Montagu, pursuing our investigations in the localities where they were found. Some of them, however, have entirely eluded our search, and one or two others we can only with doubt refer to species known to be common on the Devonshire Coast, and, therefore, likely to have been met with by that naturalist. Dr. Turton's 'British Fauna' appeared in 1807, and contained nine species of *Nudibranchiata*, only one of which was introduced from personal observation; three were those of Pennant, and five of Montagu. The species introduced by Turton he calls *Doris vermigera*. It was, without doubt, the common *Eolis papillosa*, afterwards described by Montagu in the 'Linnean Transactions.'

Another period of twenty years passed after the discoveries of Montagu, during which this tribe was scarcely noticed by any British author, though in the latter part of this period, Dr. Leach appears to have paid some attention to the subject while collecting materials for his work on the British Mollusca,† which, owing to the distressing illness that obscured his latter days, remained long unpublished, and has only just appeared, edited by his friend and former pupil, Dr. J. E. Gray. Had this work appeared at the time when it was written, much interest would have attached to it, as Dr. Leach had the merit of being the first English

\* 'Linn. Trans.,' v. 11, p. 196.

† 'A Synopsis of the Mollusca of Great Britain.'

naturalist to adopt the more modern views of the French school. At present it comes behind the knowledge of the day, and is chiefly valuable as a document in the history of the science. The Nudibranchs described in it amount to twelve, of which two or three are varieties, and the rest have now been described by other authors. The first arrangement of the British species into modern genera was given by Dr. Fleming in his 'Philosophy of Zoology,' and subsequently in his 'History of British Animals,' which appeared in 1828. This work contains twenty species of *Nudibranchiata*, six of which were introduced into our fauna for the first time; viz.—*Doris lævis*, *Doris nigricans*, *Tritonia Hombergii*, *Tritonia arborescens*, *Eolida plumosa*, and *Eolida purpurascens*. In 1838 Dr. Johnston published his excellent Monograph of the 'Scottish Mollusca Nudibranchia' in the first volume of the 'Annals of Natural History.' It comprises an anatomical and physiological account of the animals contained in the order, and goes far to extricate the synonyms from the obscurity in which they had been involved. The species new to Britain introduced by Dr. Johnston, either in this treatise, or previously in Loudon's 'Magazine of Natural History,' amount to eight: they are *Doris obvelata* (*Johnstoni*, A. and H.), *Doris pilosa*, *Tritonia plebeia*, *Triopa claviger*, *Triopa nothus*, *Melibæa pinnatifida* (*fragilis*, For.), *Eolidia Cuvieri*, and *Eolidia rufibranchialis*. From this period much more attention has been paid to the Nudibranchiate Mollusca by British naturalists, and new genera and species have been discovered in increased ratio. This has resulted partly from the more extensive explorations of our coasts by means of the dredge that have been so successfully carried on of late years, but principally from the more careful mode of investigating nature that naturalists now find it necessary to adopt. The researches of Professor Edward Forbes have added considerably to our knowledge of the *Nudibranchiata*; eight or ten new species have been contributed to the British list by his means. To Mr. Thompson, of Belfast, science is also indebted for much information and several new species in this department, obtained during his extensive investigations into the natural history of Ireland, now, unfortunately, put a period to by his untimely death. Shortly after the publication of Dr. Johnston's memoir, the authors of the present work first began to turn their attention to the *Nudibranchiata*. Since that time they have had the good fortune to introduce into our fauna upwards of sixty species, principally the result of their own personal researches; for the knowledge of a few of them, however, they are indebted to friends, particularly to Mr. W. P. Cocks, of Falmouth, to the Rev. D. Landsborough, jun., of Saltcoats, and to Mr. Barlee. The number of British species now described in this work amounts to one hundred.\*

It will not be necessary here to enumerate the additions that have been made to this department of the European fauna during the last half century. Suffice it to say that of late years much attention has been paid to the *Nudibranchiata* by continental naturalists, and several new species have been described. Among the authors treating of the subject may be mentioned, Risso, D'Orbigny, Cantraine, Quatrefages, Sars, Lovén, Delle Chiaje, Philippi,

\* The second volume of Sir J. G. Dalyell's 'Powers of the Creator displayed in the Creation,' published since the above was written, contains descriptions of twenty-five species of Nudibranchiate Mollusca, most of which are familiar to us. Two or three species may possibly be new, but the descriptions are too imperfect to found an opinion upon, especially as they come very near to others already known. Some interesting remarks on the habits and embryology of these animals will be found in the work.

and Verany. No account, however, of the Nudibranchiate Mollusca of any one country has yet been published sufficiently complete to form the basis of a comparison with our own. The best are those of Lovén,\* who gives thirty-seven species as members of the Scandinavian fauna, and of Verany, whose Catalogue of the Mollusca inhabiting the Gulph of Genoa,† includes forty-eight species of *Nudibranchiata*. The Sicilian species described by Philippi are twenty-six.‡

But it is not in a numerical point of view alone that our knowledge of this interesting tribe of animals has increased; their anatomy and physiology, their habits and alliances, have lately been studied with care and attention, and many curious facts concerning them have been ascertained. In 1841, the celebrated Norwegian naturalist, M. Sars, announced the discovery that these little creatures undergo a metamorphosis, having on their extrusion from the egg a very different form and character from those which they are afterwards destined to assume. In this first stage of their existence they have the appearance of small animalcules, swimming freely through the water by means of two ciliated lobes, and have their body covered by a nautiloid shell furnished with an operculum. Up to that time nothing approaching to a distinct metamorphosis had been known to exist in any of the true Mollusca: the announcement, therefore, did not fail to excite a considerable degree of interest. The investigation of this curious fact was pursued and extended by M.§ Lovén and other naturalists, the result of which showed that this peculiar mode of development was not confined to the Nudibranchs alone, but was common to many of the allied families; the metamorphosis, however, is most striking in those genera, which, like the former, do not bear a shell in their adult state.

Professor Milne Edwards was the first to describe¶ a curious conformation of the digestive organs in the family of the *Eolididæ*, the true signification and uses of which have since been the subject of much controversy. Having observed in a small *Calliopæa*, found at Nice, a system of branched canals connected with the stomach, and extending to the papillæ and other parts of the external surface, he thought he saw in this arrangement a blending of the functions of digestion with those of the vascular system, which he in consequence called gastro-vascular. This apparatus he compares to the system of vessels radiating from the stomach of the *Medusidæ* on the one hand, and to the cæca connected with the digestive organs of the Nymphons among the *Crustacea*, on the other.

During the same year (1842) M. delle Chiaje had published a figure of his *Eolis cristata* (*Antiopa cristata*, A. and H.), in which a similar apparatus of branching vessels connected with the stomach is represented, but without any letter-press description.||

The idea of the existence of a gastro-vascular system in the *Nudibranchiata* was promptly taken up by M. de Quatrefages, who in the autumn of that year made a communication on the subject to the French Academy of Sciences. The animal on which his investigations were founded, he conceived to belong to a new genus, the anatomy of which was subsequently given at large in the 'Annales des Sciences Naturelles.'¶¶ This Mollusk he called *Eolidina*

\* 'Index Molluscorum Scandinaviæ.'

† 'Catalogo degli Animali invertebrati, &c.'

‡ 'Enumeratio Molluscorum Siciliæ.'

§ 'Annales des Sciences Naturelles,' 2d series, v. 18, p. 330.

|| The text to this plate was published in 1844, where the whole is considered a ramified liver.

¶¶ Vol. 19, p. 274 (1843).

*paradoxum*, the specific name indicating the extraordinary compound of characters he stated it to possess. To a mouth, he says, as slightly armed as in the Medusæ, there succeeds a short canal, ending in a stomachal cavity in which digestion is effected; when, the more solid parts being ejected again, the liquid and finer products of digestion pass into a branched intestine, the main trunk of which extends down the centre of the body, terminating in a very minute anus. The branches from this central trunk pass off symmetrically on each side, ending, it is stated, in a narrow marginal canal that entirely surrounds the body; from the lateral branches arise cæca going into the dorsal papillæ. These are terminated by an ovate vesicle, through which he conceives the products of digestion to enter into the blood. Accompanying the extensive development of this so-called gastro-vascular system, M. de Quatrefages states that he found the vascular system very incomplete; the veins had disappeared, and their place had been taken by a system of lacunes without walls, in which the viscera could freely float. At the same time he considered that true branchiæ were wanting in this animal, that function being likewise in part performed by the gastro-vascular apparatus. M. de Quatrefages was, we believe, the first to describe the coloured glandular portion of the papillæ of these Mollusks, as the true liver broken up into fragments.

In communicating to the 'Annals of Natural History,' for October, 1843, the discovery of a new Nudibranchiate Mollusk on the Devonshire Coast, possessing a highly ramified digestive system, and referred to the genus *Calliopæa*, we took the opportunity of expressing our dissent from some of M. de Quatrefages' views, and gave our reasons for believing that his genus *Eolidina* was founded upon a species of *Eolis* imperfectly understood. In the same paper we stated that the ovate vesicles, which we had also observed at the ends of the papillæ, had an external opening, through which elliptical bodies with long hair-like tails were occasionally discharged.\* We likewise announced the discovery of organs of hearing in the Nudibranchs, similar to what M. Siebold had described in the *Conchifera* and the pulmoniferous Gasteropods; and at the same time gave our reasons for believing that the sense of smell was located in the dorsal tentacles, a statement which subsequent observations have tended to confirm.

Pursuing still further his investigations into the evidence afforded by these animals of a supposed degradation of the Molluscan type, M. de Quatrefages published, in March, 1844, another memoir on the subject, in which he describes five new genera, named *Zephyrina*, *Acteon*, *Amphorina*, *Pelta*, and *Chalidis*; all more or less deficient, according to his statement, in some of the characters hitherto supposed to belong to the true Mollusca.† Thinking that the anatomical characters he had detected were sufficient to unite them into a group, he proposed to detach the *Eolididæ* from the other Nudibranchs, and uniting them with the *Actæon* of Oken, and the genera above mentioned, to make of them a new order, under the name of *Phlebenterata*. (The union of functions supposed to be indicated by the peculiar branching of the stomach he afterwards proposed to call *Phlebenterism*.) The order is characterised as "Gasteropodous Mollusca, with the circulation imperfect or wanting, and deprived of respiratory organs properly so called."

In all the new genera described in the memoir, neither heart, arteries, nor veins could be found; the vascular system is consequently supposed to be entirely wanting; its place being supplied by the branching of the stomach, as already stated. In three of the genera, the

\* This has since been recognised as an urticating apparatus.

† 'Annales des Sciences Naturelles,' 3d ser., v. 1, p. 129.

anus was considered to be absent. The alimentary system of these Mollusks was thus reduced to a single opening for the reception of food and the rejection of excrementitious matters; a condition hitherto only known to exist among the inferior divisions of the *Radiata*.\*

"The Mollusks whose history I have now given," says M. de Quatrefages, "appear to me to merit the especial attention of zoologists. In the vicinity of animals which all naturalists place in the class *Gasteropoda*, we see them preserve the general aspect and external characters from which this large group derives its name, but, at the same time, we see their organisation depart in such a manner from the primitive type, that the principal systems of vital organs are modified profoundly, and that two of them, which are generally considered essential, disappear." "*Eolis*, *Calliopæa*, *Zephyrina*, &c.," he adds, "are so evidently gasteropodous Mollusks, by their external form, that all naturalists have referred them to this extensive group. To *Pelta* and *Chalidis* the same place would certainly be assigned, yet the anatomical characters of these animals exclude them not only from the class *Gasteropoda*, but even from the department of the Mollusca."†

This Memoir was presented to the French Academy of Sciences, and a commission of that learned body was appointed to report upon it. The report, drawn up by M. Milne Edwards, spoke very favorably of M. de Quatrefages' researches, which were described as leading to results highly important in the history of the Mollusca; and it further expressed an opinion that among the works by which zoology had been enriched for many years, there was, perhaps, not one which embraced so great a number of new and curious facts. This report was adopted by the Academy, as was also a resolution expressing the importance of making similar researches on the *Phlebotenterata* of the Mediterranean.

In consequence of this recommendation, M. de Quatrefages was sent out by the French government, in the summer of that year, on a scientific expedition to the coast of Sicily, in company with M. Milne Edwards and M. Blanchard. Many valuable essays and monographs, resulting from this expedition, have appeared from time to time in the 'Annales des Sciences Naturelles,' and have since been published in a collected form. Among these no account of the researches of M. de Quatrefages on the Phlebotenterate Mollusks have yet been given to the public. We learn, however, from a letter addressed to the Academy of Sciences by that gentleman, that his researches had tended to confirm the results he had already arrived at. In June, 1844, he writes that he had had the good fortune to collect twenty-one new species of these animals, a small number only of which could be included in known genera, and that he had studied the anatomy of them in great detail. He states that the circulatory apparatus did not exist, even in a rudimentary state, in the greatest number of the *Phlebotenterata*. That in the whole of their external characters they resembled the Nudibranchs, but that they were distinguished from them by the tendency to a bilateral symmetry of the external organs, and by the repetition of the same organs in longitudinal series; and that in all the function of digestion was confounded with those of respiration and circulation.‡

\* It may be necessary to state, that though M. de Quatrefages adopts this opinion, and founds his generalisations upon it, he afterwards, in the same essay, makes a reservation of the possibility of his having overlooked the anal opening in some of the species.

† Loc. cit., p. 168.

‡ 'Comptes Rendus,' v. 19, p. 190.



The statements of this distinguished anatomist had been far from giving the same satisfaction to naturalists in general that they had done to the commission of the Academy. Their importance, however, had not been overrated; as, should they prove to be founded in truth, they would have an influence much beyond the dismemberment of a small order of Mollusks, or the establishment of one or two new families. Naturalists had hitherto placed great confidence on deductions drawn from analogy and the correlation of parts. Their experience had shown them that the works of nature exhibited such an uniformity of design as enabled them, from the existence of certain characters, to infer the existence of others with which they had been found to be uniformly associated. Upon such a faith in the constancy of nature, most generalisations are founded. The discoveries of M. de Quatrefages tended to shake this confidence, and to vitiate in future all arguments drawn from analogy. It was not to be wondered at, therefore, that his statements were received with mistrust, and the supposed facts submitted to a rigorous scrutiny.

Among the foremost to oppose these views was M. Souleyet. In a communication to the Academy of Sciences,\* this naturalist expresses his conviction, founded upon a careful anatomical investigation, that the so called gastro-vascular apparatus was no other than a system of highly developed biliary ducts, rendered necessary by the dismemberment of the liver in these animals. Rejecting, therefore, the idea of the union of functions assigned to them, he proposed to call these vessels gastro-biliary. He demonstrated, from the anatomy of *Eolis*, between which genus and *Eolidina* he could see no essential difference, that the marginal canal described by M. de Quatrefages, and considered by him analogous to that of the Medusæ, did not exist, and further asserted that in *Eolis* the vascular system was not less perfect than in the other Mollusca. No degradation from the usual type of the class was therefore to be found in the animals examined.

In a Report to the British Association for the Advancement of Science, in 1844, we again objected to most of the opinions of M. de Quatrefages on this subject. And in the first part of a paper on the anatomy of *Eolis*,† published in 1845, Mr. Hancock and Dr. Embleton pointed out several errors of detail in that gentleman's memoirs. They there take the same view of the gastro-vascular system as that expressed by M. Souleyet.

Subsequently, M. de Quatrefages entered into a general exposition of his views on the organisation and arrangement of the animal kingdom, showing that with these his observations on the anatomy of the Mollusca perfectly agreed. In conformity with the views of Professor Milne Edwards, he contends for a plurality of series in the animal kingdom, and the degradation of many of them; and he further states that, in numerous instances, the general form of the body and the internal organisation are perfectly independent of each other. Phlebenterism, he says, is not confined to the Mollusca: "It exists in the animal kingdom taken as a whole, and in many of the secondary and tertiary series which concur to form it. Nearly throughout, we see it coincide with the manifest degradation of the entire organisation. Almost always it coincides with the simplification or complete annihilation of the organs of circulation."‡

The observations of M. Souleyet, in reply to those of M. de Quatrefages, were, for the most part, directed to the two principal points in dispute; namely,—the function of the branched

\* 'Comptes Rendus,' v. 19, p. 355 (1844).

† 'Ann. Nat. Hist.,' v. 15, pp. 1, 77.

‡ 'Comptes Rendus,' v. 19, p. 809.

apparatus of the stomach, and the presence or absence of veins in the circulatory system. It is unnecessary here to mention in detail the whole of the papers communicated to the Academy, or published in the French journals in connexion with this controversy, which was carried on for some time with considerable energy. We may state, however, that M. de Quatrefages admitted the existence of some errors in his earlier papers, and was willing to give up the *Phlebenterata* as a separate order, but still maintained the correctness of his views on the gastro-vascular system and the degradation of types. He proposed to retain the term Phlebenterism, in a more extended signification, to designate that species of degradation which consists in the union of different functions in one system of vessels, to be found, according to his views, in all divisions of the animal kingdom.

We may perceive in the desire to discover proofs of this theory the source of most of the errors with respect to facts which we cannot doubt that M. de Quatrefages has committed in his Memoir on the *Phlebenterata*. Since its publication we have discovered on the English coasts undoubted examples of most of the genera there described, and we have been able to demonstrate\* that no degradation of type, to the extent that he describes, is to be found in any of them. In every case we found a heart and blood-vessels more or less complete, and the anal opening was present in all. So far as regards these points, therefore, we may dismiss as purely imaginary the extreme degradation of type which some of these little animals were supposed to exhibit.

The matter in dispute was ultimately referred to a new commission of the Academy of Sciences, whose report, drawn up by M. Isadore Geoffroy Saint Hilaire, was presented to the Academy on the 13th of January, 1851.† The commission, after considering attentively the evidence submitted to them by the contending parties, came to the resolution, that the existence of a heart, arteries, and branchio-cardiac vessels in the Phlebenterate Mollusca is proved, and that a regular circulation does exist, but that whether it is completed by a system of veins or by means of lacunes is still open to dispute. With respect to the functions of the branched vessels called gastro-vascular, the commission think that further evidence is desirable, but from the existence of a system of vessels specially appropriated to the circulation, as well as of organs performing (at least in part,) the office of respiration, they think that the threefold office assigned to them by M. de Quatrefages can scarcely be maintained.

Meanwhile, M. de Quatrefages brought the subject before the Biological Society of Paris, and a commission of that Society was likewise appointed for its investigation. After a careful examination of the subject, they agreed to a report which was drawn up by Dr. Charles Robin.‡ This able report, which is extremely elaborate, filling a pamphlet of 132 closely printed pages, appeared very nearly at the same time with that of the Academy. On the two main points in dispute the commission came to the conclusion that M. Souleyet is correct, and dismiss the idea of Phlebenterism as untenable. They consider the ramifications of the digestive system to be true biliary ducts in connexion with a divided liver, and that they do not fulfil any other function than the usual one of that organ. They, moreover, consider that the circulatory system in these animals (*Eolis*, *Actæon*, &c.) is complete, the so-called lacunes being similar to the blood-sinuses known to exist in particular cases throughout all departments

\* 'Ann. Nat. Hist.,' v. 13, p. 161; v. 18, p. 289; and 2d series, v. 1, p. 101.

† 'Comptes Rendus Hebdomadaires,' v. 32, p. 33.

‡ 'Rapport à la Société de Biologie,' &c., par M. le Dr. Charles Robin. Paris, 1851.

of the animal kingdom. They further express an opinion that the facts upon which is founded the doctrine "that the form of the body and the internal organisation are independent of each other," are not real, and that that hypothesis cannot be any longer maintained.

Prior to the appearance of these reports, a series of very excellent papers had been published by M. Milne Edwards, taking an extended review of the circulatory system in the Mollusca. He states his conviction, founded on extensive researches undertaken for the purpose, that the venous system is incomplete throughout the whole of this large division of the animal kingdom. In all instances he finds the true veins more or less imperfect, their place being supplied by a series of lacunes, and the blood in most cases also flowing into the abdominal cavity. The condition of the Nudibranchs he does not consider to be exceptional.

The difference of opinion amongst these distinguished naturalists with respect to the circulatory system, has resolved itself into a very subtle anatomical fact. Both parties admit the existence of large cavities into which the blood flows, but, on the one part, they are considered as mere expansions of the vessels into blood-sinuses, and hence the vascular system is uninterrupted; while on the other, they are held to be lacunes or gaps in the continuity of the vessels, showing a yet imperfect state in the structure of these organs, and thus forming an intermediate stage in the development of the vascular system, between its first imperfect appearance in the lower animals, and the complete system of closed vessels, only to be found, according to M. Milne Edwards, in the *Vertebrata*.

A very elaborate monograph of a species of *Tergipes*, found on the shores of the Black Sea, was submitted to the Academy of St. Petersburg, by Professor Nordmann, of Odessa, in 1844, and appeared in the 'Annales des Sciences Naturelles,' in 1846. M. Nordmann's view of the digestive and circulatory systems appear to agree pretty nearly with those of Messrs. Milne Edwards and De Quatrefages. The liver, however, he had entirely misunderstood. He had observed auditory capsules and otolithes, and that the ovate vesicles of the papillæ occasionally discharge "a kind of mucus." He gives a full account of the embryology, and has traced the ulterior development of the young animal further than had been done by other authors.

It is unnecessary here to analyse many excellent essays on the *Nudibranchiata* that appeared nearly contemporaneously with or subsequent to those already mentioned, evincing the interest that these little mollusks had excited among European naturalists. The papers of Professor Allman 'On the Anatomy of *Actæon*, with remarks on the *Phlebenterata*,' and of Dr. John Reid 'On the Development of the Nudibranchiate Mollusca,' in the 'Annals of Natural History,'\* and those of M. E. Blanchard, 'Sur l'Organisation des Opisthobranches,' in the 'Annales des Sciences Naturelles,'† may be cited as affording many interesting details of anatomy and development. So far as these authors touch upon the question of Phlebenterism, their opinions are generally more or less opposed to those of M. de Quatrefages. In a paper on the 'Anatomy of Doris' by Mr. Hancock and Dr. Embleton, read at the Edinburgh Meeting of the British Association, in 1850, and since published in a much enlarged form in the 'Philosophical Transactions of the Royal Society,' a portal heart and a sympathetic system of nerves were shown to exist in the *Nudibranchiata*, being the first time that the existence of these organs has been fully demonstrated in any of the invertebrated animals.

From this brief history of the study of these Mollusks it will be seen that many important

\* Vol. 16, p. 145, and vol. 17, p. 377.

† 3d ser., vol. 9, p. 172, and vol. 11, p. 74.

points in their anatomy and physiology have been elucidated by recent investigations. We shall now proceed to give a more detailed account of the present state of our knowledge on the subject.

**ANATOMY.** The *Nudibranchiata* exhibit a high state of organisation, not much inferior to that of any of the Gasteropods; and as, perhaps, in no other Molluscan group has the anatomy been so perfectly investigated, we feel ourselves in a position to take a comprehensive view of their structure, at least so far as the British forms are concerned. Our references to foreign species must necessarily be very limited; as comparatively few of them have been dissected, and even their external characters are, in too many instances, very imperfectly known. Fortunately, however, the British list comprises types of all the larger groups and of a great variety of the smaller ones, so that we are enabled, from our indigenous species alone, to attain a very accurate knowledge of the organisation of the whole order.

*Alimentary System.* All the Nudibranchs are provided with a powerful muscular buccal apparatus, which has, in some instances, appended to it a gizzard, as in *Lamellidoris*, *Goniodoris*, *Idalia*, and others. The oral aperture is always guarded by fleshy lips, and the mouth itself is furnished with a tongue, bearing a spiny prehensile membrane, and occasionally with lateral corneous jaws. *Tethys* is the only exception, and in it there are neither jaws nor tongue; neither is the buccal organ so muscular nor so distinctly defined as usual. The jaws are highly developed in the *Tritoniadæ* and the *Eolididæ*; in the former they are always present, in the latter sometimes wanting, as is the case in *Doto*, *Hermæa*, *Stiliger*, and *Alderia*. A few of the *Polycerinae* are also furnished with lateral jaws; but they are small, and do not appear to be very efficient cutting instruments. *Ægirus* has an upper corneous jaw or tooth resembling that of *Limax*; and a minute rudimentary under jaw may be detected in some of the *Dorides*.

The tongue is composed of a muscular apparatus bearing a stiffish membrane, furnished with small teeth or spines. These are divided into two kinds, central and lateral, distinguished by their position, and generally, when both are present, by a difference in form. The former have been called *dentes* by Professor Lovén, the latter *uncini*; and the portions of the tongue on which they are placed, are distinguished by that naturalist, under the names of *rhachis* and *pleuræ* respectively. We have not thought it necessary to preserve these distinctive appellations. In the *Dorididæ*, the lateral spines are always developed, the central only occasionally. Both kinds are present in the *Tritoniadæ*. The lingual membrane in the typical *Dorides*, and in the *Tritoniadæ*, is very broad, and is supplied with numerous spines; it is narrow in *Lamellidoris* and *Acanthodoris*, there being very few spines in each transverse row,—in some of the species as few as four. In such, the whole of the lingual spines do not amount to more than 112, while in *Doris tuberculata* there are no less than 6,000, and in *Tritonia Hombergii*, upwards of 36,000. In the *Polycerinae*, the lingual membrane is mostly narrow, and devoid of central spines, and with one, two, or three, large, recurved spines on each side next the median line. External to these, there are generally a few depressed plates or rudimentary spines. *Ægirus* and *Ceratosoma*? are, however, exceptions, for in them the spiniferous membrane is broad, bearing numerous spines, similar to those of *Doris*.

The lingual membrane in the typical *Eolididæ* is very narrow, being furnished with a longitudinal series of central plates or spines. In the sections of *Eolis* represented by *E. tricolor* and *E. rufibranchialis*, however, there is on each side a single additional lateral spine,

and in *Dendronotus* there are several. In *Lomanotus*, *Antiopa*, and *Proctonotus*, the lateral spines are numerous, the lingual membrane being broad in these genera, as in *Doris*. *Lomanotus* has no central spines. *Hermæa*, *Stiliger*, and *Alderia*, also present a peculiar modification of this organ. In them there is a single longitudinal series of plates, as in *Eolis*; but they are articulated, resembling the vertebræ of the spinal column, and each bears a very large, broad, simple spine.

In addition to the dentigerous tongue, *Doris repanda*, *D. pilosa*, *Goniodoris*, *Idalia*, and *Ancula*, have a spiny, prehensile collar, placed at the entrance of the buccal organ, on what has been denominated the buccal lip. *D. coccinea*, *D. bilamellata*, and *Euplocamus croceus*, are also provided with a similar collar; but in these the surface of the organ is roughened with papillæ or imbricated scales. The genera in which this apparatus is most strongly developed, are characterised by narrowness of tongue and deficiency of jaws. It would therefore seem probable, that the collar is a compensation for diminished prehensile power, consequent upon these circumstances. At least it is rarely associated with a powerful tongue, and never with lateral jaws. There is a narrow belt of spines on the outer surface of the jaws of *Tritonia*, but this would seem to differ from a prehensile collar. The tongue, in all the Nudibranchs, is more of a prehensile than a rasping instrument: in *Eolis* the protruded jaws lay hold of its prey, cutting out lump after lump, which the tongue, advancing, seizes by the aid of its recurved spines, and with a backward motion carries to the entrance of the œsophagus. The broad tongue of *Doris* acts at once in the capacity of both jaws and tongue; it is hollow or scoop-formed, and, on being applied to the surface of its food is flattened out; the sides then collapse, when the spines laying hold, a piece is torn or licked out, as it were, and brought immediately to the back of the mouth by the withdrawal of the tongue. The tongue in *Tritonia* must act much in the same way, but here, probably from the different nature of its food, it requires the assistance of a pair of powerful jaws. In most of the species with a prehensile collar, the lingual organ is narrow, has lost the scoop-like character, and is functionally very similar to that of *Eolis*. The collar, in these forms, will seize the prey somewhat in the manner of jaws; then the tongue will be advanced, and do its work of carrying the food to the œsophagus.

The œsophagus, stomach, and intestine are well marked; the former is generally short and passes from the upper surface of the buccal mass. In the *Dorididæ*, and in a portion of the *Tritoniadæ*, there is a pair of well-developed salivary glands, pouring their secretion into the buccal cavity, one on each side of the œsophagus. The *Eolididæ*\* appear to be devoid of these organs, with the exception of *Tethys*, a very abnormal genus, in which they are quite rudimentary.

The stomach varies considerably in size and form; and, in the *Dorididæ*, is frequently buried in the liver. In them, too, there is occasionally, besides the buccal gizzard already

\* We have described *Doto* as possessing salivary glands, in the account of that genus. A more extended knowledge of the anatomy of these animals has, however, induced us to change our opinion respecting the nature of these organs, which we are now disposed to look upon as glands for secreting mucus to lubricate the foot, similar to those for the like purpose pointed out in *Fiona*. The salivary glands of *Calliopæa* (*Stiliger*) described by M. Souleyet, will probably prove to be of the same nature. The minute salivary glands described under the head *Eolis*, we are now satisfied do not exist. We were deceived in our original examination by the lodgment of extraneous matter between the jaws and the fleshy walls of the mouth.



noticed, an anterior stomach or crop, formed by a dilatation of the œsophagus. The most remarkable modification of the gastric organ is found in *Scyllæa*, where it is armed with a belt of horny plates or teeth. A similar armature of the stomach is not, as far as we are aware, to be met with in any other Nudibranch.

The intestine is always short—in some of the *Eolididæ* excessively so, never convoluted, and, in the *Dorididæ*, terminates in an anal opening, on the medio-dorsal line, in the centre of the branchial circle. In the *Tritoniadæ*, and in many of the *Eolididæ*, the vent is on the right side. It is situated on the medio-dorsal line in *Antiopa*, *Proctonotus*, *Alderia*, *Hermæa*, and *Stiliger*; in the three former, towards the posterior extremity, in the two latter, far forward in front of the heart. In some others of the *Eolididæ* it is latero-dorsal.

The liver presents two great types of form. In the *Dorididæ* and *Tritoniadæ* it is entire (excepting in *Scyllæa*, where it is broken up into six or seven globular masses), occupying its normal abdominal position; in the *Eolididæ* it is more or less diffused. In those genera with an entire liver, it is very bulky, pouring the hepatic fluid into the stomach by one or several large ducts. When the gastric organ is free, as in *D. tuberculata*, it receives only one duct; but in those species with the stomach buried in the liver, the bile enters through several large openings in its under surface. In *Scyllæa pelagica*, and *Doris tuberculata*, the biliary secretion enters at the cardiac extremity of the stomach: in *Tritonia Hombergii*, at the pyloric.

The diffusion of the liver is first seen in *Tethys*,\* but in it the great bulk of the hepatic organ is still found in the abdominal cavity; and the gastro-hepatic system is only in a rudimentary state, though developed distinctly on the plan of that of *Eolis*. Lateral vessels are given off from the stomach and liver, which pass to, and seem to penetrate, the papillæ on the sides of the back between the branchial tufts. In the greater number of the *Eolididæ*, however, the liver has entirely disappeared from the abdomen, and is broken up into numerous minute portions or glands which are thrust into the branchial papillæ. The delicate ducts from these glands pass inwards and unite to form great hepatic ducts or trunk channels, which open into the stomach. In the *Proctonotinæ*, *Glaucinaæ*, and *Eolidinæ*, there are three such trunk-channels, two lateral and anterior,—one central and posterior: in the last-named sub-family the posterior duct lies above the ovary; in the two others, below it, shewing, in this respect, their relationship to the *Dorididæ* and *Tritoniadæ*, in both of which the ovary overlies the liver. The *Hermæinæ* have four great gastro-hepatic ducts, all of which are lateral,—two being anterior and two posterior. The great ducts, and the numerous branches leading to them from the glands of the papillæ, form the gastro-vascular system of M. Milne Edwards, and M. de Quatrefages.

The gland of each papilla has appended to its extremity an ovate vesicle, which communicates externally by a minute orifice at the apex of the respiratory organ. This vesicle, which has been observed only in *Eolis*, has the power of discharging filamentous urticating bodies.

\* In the account of *Scyllæa*, under the head of the genus, we have described a series of vessels or tubes passing from the hepatic globular masses to the skin and branchial tufts; these we deemed at the time to represent, in a rudimentary form, the gastro-hepatic system of the *Eolididæ*, but we are now inclined to consider them as veins, carrying blood from the biliary organ to the aerating surface, and therefore of the same nature as the hepatic veins in *Tritonia*, and as the great hepatic trunk vein in *Doris*.

In the *Dorididæ* there is generally a small pancreatic organ—a glandular sac—opening into the intestine at its junction with the stomach. In *D. tuberculata*, this organ is situated at the cardiac extremity of the gastric pouch. There is also a rudimentary pancreas in *Tethys*.

*Reproductive Organs.* All the Nudibranchs are hermaphrodites, each individual being furnished with male, female, and androgynous parts. These organs, taken together, are very bulky, and occupy the greater portion of the abdominal cavity. They communicate with a common vestibule, opening upon a nipple-like process on the right side of the body, and always below the mantle, when it is present.

The male intromittent organ is exerted in front; behind it opens the vulva, and a little above and between these two orifices is the vaginal opening, leading to the androgynous apparatus. The penis is usually long, tapering, pointed and perforated, and the testis is composed of a convoluted glandular tube, more or less voluminous, which, in some of the *Dorididæ*, is rolled up into a dense mass, forming a compact gland-like organ. One end of this tube is connected with the intromittent organ, the other with the oviduct.\*

The ovary is of considerable magnitude, and occupies the posterior portion of the abdomen. In the *Dorididæ* and *Tritoniadæ*, it is spread over the upper surface of the liver; in the *Eolididæ*, it is a bulky, lobulated organ, filling up the space held by the liver in the other members of the order. The oviduct, as it leaves the ovary, is very slender; it soon widens and is more or less convoluted, and, after joining the testis, and receiving a duct from the androgynous apparatus, sinks into a large mucus-gland, composed of a convoluted tube, that opens into the vulva. This gland secretes the mucus, which, on reaching the surrounding water, is transformed into the transparent gelatinous substance in which the eggs of the Nudibranchs are always imbedded.

The androgynous apparatus consists of the vagina, or copulatory channel, which unites with the oviduct, and has seated upon it one or two spermathecæ: in the *Dorididæ* always two; in the *Tritoniadæ* and *Eolididæ* generally only one. The connexion of the androgynous with the female parts is somewhat modified in *Tritonia* and *Tethys*.

Such is the predominant arrangement of these organs. There are, however, occasional modifications. Thus, in *Doris Johnstoni*; and *Doris tomentosa* (of Verany) the male organs have added to them a stiletto, which lies within a sac in front of the penis: this sac can be everted, and when so, the stiletto projects from the apex of a long penis-like organ. This, like the dart of *Helix*, is probably for a stimulating purpose during, or previously to, coitus. But the *Hermæinæ* present the most important deviations. In this sub-family the male and female orifices are divided from that of the androgynous apparatus. The two former openings are placed close together at the base of the right tentacle, and when these parts are fully retracted, only one opening is visible externally. The copulatory orifice is removed to some

\* Having completed our investigation of the anatomy of the various genera, we think it only right to state that several facts have been observed, particularly in the anatomy of the *Polycerina*, which would seem to favour Her Heinrich Meckel's views as to the compound nature of the ovary of these animals. When in season, it is distinctly composed of two parts, one containing ova, the other spermatozoa, and these latter have been found lying in parallel order, and apparently in an incipient state. The oviduct is, however, simple, and does not hold within it a vas deferens, as supposed by the same high authority. Therefore, if the so-named ovary be really composed of ovary and testis, the oviduct must be equally oviduct and vas deferens.

little distance backwards. The testis is composed of two much-branched tubes, which lie one on each side of the body, and extend almost from the head to the tail. The ovary is formed of a number of distinct, globular, ovigerous sacs, which are united by systems of minute tubes to a large central oviduct. This duct, on its way to the vulva, communicates, as usual, with the testis, spermatheca, and mucus-gland. The apex of the intromittent organ in *Alderia* carries a crystalline spur.

*Organs of Circulation and Respiration.* These consist of central organs of propulsion,—a systemic and portal heart,—arteries, veins, and sinuses or lacunes; and of laminated, branched, or papillose branchiæ, arranged either on the median line, or along the sides of the back.

The systemic heart lies always immediately below the skin of the back, and consists of two chambers,—an auricle and a ventricle,—enclosed within a pericardium. A large aorta passes forwards, distributing branches to the various organs; and the blood is returned again to the heart in a partially aerated state, only a portion of it having passed through the branchiæ. The blood system is somewhat modified in each of the three families of the order. In the *Dorididæ*, the systemic circulation is twofold, general and partial. By the former, the larger quantity of the blood, after supplying numerous organs, reaches a general system of sinuses or inter-visceral spaces; then passes into the sinuses or cellular tissue of the skin, and is returned to the auricle by two lateral veins. By the latter, that blood only which goes to the liver-mass, comprising liver, ovary, and kidney, enters the special respiratory organ by a great hepatic or afferent branchial vein, and, after circulating therein, arrives at the auricle from behind by a single, median, efferent or branchio-cardiac vein.

The partial or hepatic circulation is probably provided with a complete system of capillaries, and has, in connexion with it, a portal circulation, to which is appended a ventricle or portal heart, that lies under the pericardium, the latter being related to the former as an auricle. This portal heart propels venous blood into the renal and hepatic organs.

In the *Tritoniadæ*, the systemic circulation is likewise divided into two portions; but in this family, taking *Tritonia* as the type, there are six afferent branchial, or hepatic veins; three passing from each side of the liver mass to the branchiæ. The blood is returned to the auricle by two lateral venous trunks, or efferent branchial veins, which, however, do not convey merely aerated blood from the gills, but also drain the blood-sinuses of the skin; they therefore carry to the heart a partially aerated or mixed stream, and are not to be looked upon as the anatomical equivalent of the efferent branchio-cardiac vein of the *Dorididæ*, but rather, as the homologue of the two lateral veins, bringing the blood from the skin to the auricle. The hepatic circulation of the *Tritoniadæ* is undoubtedly as complete as that of the *Dorididæ*, and is also provided with a portal heart.

The systemic circulation in the *Eolididæ* is simple, there being apparently no partial or hepatic circulation. All the blood sent to the various organs passes into the great abdominal sinuses, or inter-visceral spaces, and then enters the cellular tissue of the skin, a portion of it penetrating the branchial papillæ, and in this way it is returned to the heart by a system of efferent branchial veins, which combine to form three great trunks, two being lateral, and one posterior; these bearing the blood from the gills, also receive it from the sinuses, or cellular tissue of the skin, and consequently pour into the auricle a partially aerated stream, as in the *Tritoniadæ*. The *Eolididæ* are likewise provided with a portal heart, which may probably supply venous blood to the glands of the papillæ.

In connexion with the vascular system in the *Dorididae*, there is a gland-like organ which generally overlies the buccal mass. This is copiously supplied with blood by a branch from the aorta. Its function is unknown, but it may probably be analogous to some of the vascular, ductless glands of the higher animals.

The flow of the blood is rapid; the pulsations of the heart varying, in the different species, from fifty to a hundred in the minute.

It is evident, from the state of the circulatory apparatus, that respiration is performed only in part by the branchiæ. In all the three families, the skin, which is covered with vibratile cilia, acts as an imperfect accessory breathing organ, and thus the blood is returned to the heart in a partially aerated condition. The branchiæ are most highly developed in the *Dorididae*, in which they are always laminated; the blood is brought to them by a distinct afferent vein, and, after circulating over the respiratory surface in a definite course, is returned to the auricle by another distinct or efferent vein, there to be mixed up with that brought from the skin. In the *Tritoniadæ* the gills have a similar laminated structure, and the branchial circulation is apparently as complete as in the *Dorididae*; but the efferent branchial veins are not distinct, but communicate with the sinuses of the skin, and therefore transmit to the auricle a mixed stream. The *Eolididæ* have the respiratory organs less perfectly organised; they are generally papillose, though sometimes branched. Here there are apparently no afferent branchial veins; the blood being at once drawn from the sinuses of the skin into a vessel which passes up one side of the papilla: it then filters through fine cellular tissue, under the aerating surface, into another vessel on the opposite side, and so passes on in distinct vessels to the great efferent, branchio-cardiac trunks, which conduct it, mingled with the blood received from the sinuses of the skin, to the auricle. The gills, whether laminated or papillose, are clothed with vibratile cilia.

*Renal Organ.* An excreting organ, which, from analogy there can be no doubt is of a renal character, exists in all the Nudibranchs, though little is known of its anatomy, except in the *Dorididae*; in all, however, the portal heart and the excretory orifice have been detected. This orifice is invariably associated with the anus. The renal organ is, in the *Dorididae*, a large membranous sac, more or less branched, lying immediately below the pericardium, and having its floor firmly attached to the liver-mass. It is supplied with arterial and venous blood, by the systemic and portal hearts; both of which send numerous vessels to ramify in its walls.

*Nervous System.* This presents a high degree of concentration,—perhaps higher than in any other group of Mollusks,—and is divided into two very distinct portions;—one, the cephalic or excito-motor; the second, the splanchnic or sympathetic: these two portions intercommunicate at several points. The cephalic ganglia are situated at the origin of the œsophagus, and naturally divide themselves into two sets, which may be denominated respectively œsophageal and buccal, or supra- and infra-œsophageal. The latter are attached to the buccal mass; the former are more immediately related to the œsophagus, upon which they are always seated, and about which they, with their commissures, form one or more constricted collars. The two sets of ganglia are also interconnected.

The œsophageal set is composed essentially of three pairs of principal ganglia, howsoever they may be fused or blended together, and of one or two accessory pairs; and, in the *Dorididae*, there is an additional visceral ganglion. The principal ganglia are the cerebroid,

the branchial, and the pedial; the accessory,—the olfactory and the optic. They are placed symmetrically with regard to the median line, there being one of each pair on either side. The cerebroids are invariably above the œsophagus; they hold a central position, and are united by a very short commissure across the median line, being usually in contact with each other, and, when distinct, are connected by commissures with the branchial and pedial: these two latter of the same side also intercommunicate. The branchials, as well as the cerebroids, are generally above the alimentary tube, and are frequently fused with them, so as to form a single mass on each side of the median line. This is not uncommonly the case in the *Dorididæ*, but seems to be universally so in the *Tritoniadæ* and *Eolididæ*. The pedial ganglia are also occasionally placed above the œsophagus; but more frequently they are at the sides, and sometimes, though rarely, they are below it, as in *Doris pilosa*, *Ancula cristata*, *Lomanotus marmoratus*, and *Doto fragilis*. In the *Dorididæ*, the visceral ganglion is attached to the under side of the right branchial; it is always small. In the *Tritoniadæ* and *Eolididæ* this ganglion is apparently absorbed into the branchial. The fusion of the œsophageal ganglia is most complete in *Tethys leporina*. In this species all the three pairs are situated above the alimentary tube, and are so perfectly united into one mass, that it would be scarcely possible to ascertain the boundaries of its component parts, were it not for the manner in which the nerves are distributed.

The œsophageal ganglia are united to the buccal, by two long commissural cords, which pass from the under side of the cerebroids and embrace the gullet, forming a wide collar—the buccal—around that tube. A large sub-œsophageal commissure, passing between the œsophageal ganglia of either side, completes a second or great posterior œsophageal collar. This commissure varies in length, in accordance with the position of the ganglia: if they are all above the alimentary tube, it is long; if partly below, very short. It is composed of either two or three cords. In the *Dorididæ* and *Tritoniadæ* there are generally three, two of which belong to the pedial ganglia, one to the branchial and visceral. This great œsophageal collar is, therefore, in these two families really both a pedial and branchial commissure. In the *Eolididæ*, however, it generally consists of only two cords, and they both come from the pedial ganglia; the branchial commissure is nevertheless invariably present, but is quite distinct from that of the pedial, so that here the great posterior collar is represented by two separate collars. Still there is apparently another sub-œsophageal commissure. *Doris tuberculata* has a fine cord, uniting the cerebroid ganglia below the buccal mass. Thus, it seems probable that in the Nudibranchs all the three principal pairs of œsophageal ganglia are united by separate cords, below the alimentary tube.\* But at present we must be satisfied with enunciating the general facts; that in the *Eolididæ* the œsophagus is encircled by three collars, namely:—first, the great œsophageal—the pedial; second, the branchial; third, the buccal; and that in the *Dorididæ* there are usually two; first, the great œsophageal, comprising the pedial and branchial commissures; and second, the buccal.

The cerebroid ganglia give nerves to the channel of the mouth, to the lips and oral tentacles, also to the veil, when it is formed by the fusion of these latter organs: they have likewise attached to them the two pairs of accessory ganglia,—the olfactory and the optic.

\* This additional or cerebroid collar does not appear to be peculiar to the Nudibranchs, for we have also detected it in *Pleurobranchidium Meckelii*.

The latter are most developed in the *Dorididæ*, but are never large, and are not always present; the eyes being frequently supplied by simple nerves. The olfactory ganglia are never absent, and are occasionally of considerable magnitude; in some of the *Eolididæ* they are half the size of the cerebroids, and in *Tritonia* too they are very large. In the *Dorididæ* they are sessile; but they are removed to a considerable distance from the cerebroids, by the interposition of long nerves or commissures, in most of the *Tritoniadæ* and *Eolididæ*. In these cases, the olfactory ganglia are placed just within the base of the tentacles. The auditory sacs are also in connexion with the cerebroids, upon which they are seated; in the *Dorididæ* and *Tritoniadæ*, on the under side near the commissure uniting them to the pedials; in the *Eolididæ*, on the upper surface immediately behind the eye. In this respect it would appear that the animals of this order disagree with the other gasteropods, in which the auditory sacs are attached to the pedial ganglia. In the Heteropods, however, they are always, as in the Nudibranchs, connected with the cerebroids. The cerebroids, as already stated, give off the cords or commissures, which unite the œsophageal ganglia to the buccal.

The branchial ganglia distribute nerves to the mantle or dorsal skin, and to the branchial ganglia of the sympathetic system; and, in the *Eolididæ*, give off from the under side, a nerve or two in connexion with the sub-œsophageal commissure or branchial collar, which go to the viscera. In the *Dorididæ* there are three or four visceral nerves which originate in the visceral ganglion, attached to the right branchial. All these nerves go to the chief centres of the sympathetic system of the viscera. In some of the *Polycerinæ*, however, the genital nerve comes off from the side of the right branchial ganglion.

The pedial ganglia send all their nerves to the foot.\*

The buccal set of ganglia are generally two pairs:—the buccal proper, and the gastro-œsophageal. The buccal pair, as already stated, are connected by commissure with the cerebroids. The gastro-œsophageal are united to the buccal, upon which they are generally sessile. The latter give their nerves to the buccal mass and tongue, and are connected with the sympathetic plexus on the buccal organ. The gastro-œsophageal supply the salivary glands, and send two large nerves—the *par vagum*,—down the œsophagus, which terminate in two of the principal ganglia of the gastro-hepatic plexus of the sympathetic system.

*Sympathetic System.* This is composed of numerous minute, variously formed ganglia, connected together by open plexuses of nerves, spread out over the viscera. The principal of these plexuses are,—the œsophageal, the gastro-hepatic, the pyloric, the intestinal, the branchial, and the genital. Similar ganglia and nerves have also been found in connexion with the heart, arteries, buccal mass, and skin. This system, as we have seen, is connected with both sets of cephalic ganglia, with the œsophageal, through the visceral and branchial centres, and with the buccal by the *par vagum*, and gastro-œsophageal ganglia.

This portion of the nervous system has been fully examined only in the *Dorides*, but extensive traces of it have been found in the *Polycerinæ*, *Tritoniadæ*, and *Eolididæ*; and in the latter family a very striking modification of the buccal plexus exists. In *Eolis* and *Fiona*, a large nerve is given off on either side from a small ganglion, buried in the muscles of the buccal mass, and is also in connexion with the buccal ganglia. These nerves supply the

\* In our description of the anatomy of *Eolis*, one of the pedial nerves is erroneously stated to supply the skin of the sides of the back.



hepatic glands of the branchial papillæ, and probably represent, along with the ganglia from which they originate, a portion of the gastro-hepatic plexus of the Dorides.

*The Senses.* All the Nudibranchs are provided with auditory capsules, which contain numerous vibratile otolithes in all the genera, except *Embletonia* and a portion of *Eolis* (*Cavolina* and *Tergipes*), where there is only a single large, spherical otolithe; the auditory organs thus, in these, retaining their embryonic condition. Eyes are also universally present, and are only a little inferior in organisation to those of the higher gasteropods. The dorsal tentacles are the organs of smell, and, judging from their great development, this sense must be more acute in most of the Nudibranchs than it is in any other Mollusk, with the exception, perhaps, of *Nautilus*. Olfaction, however, in these animals, probably is not so much to assist in the discovery of alimentary matters, as to give warning of the unhealthy state of the surrounding medium, arising from putrescence or other causes; for the Nudibranchs, breathing more or less by the whole surface, and being entirely unprovided with covering of any kind, are exceedingly liable to be affected by external influences. The sole object of vision appears to be that of ascertaining the presence of light, and thus directing the animal in its search for shelter in dark and concealed places. Touch undoubtedly resides everywhere in the skin, but is specialised in the oral tentacles and parts about the mouth. The lips and channel of the mouth are probably the seat of taste.

*The Skin.* This varies very much in thickness in the several groups; it is delicate and soft in the *Eolididæ*, and in most of the *Polycerinae*; while in the *Tritoniadæ* and *Dorides*, it is thick and coriaceous, and generally more or less roughened with tubercular excrescences. In the *Dorididæ* it is always stiffened with imbedded calcareous spicula of various forms, which in the *Polycerinae* are for the most part scattered, and not very numerous; but in the *Dorides* are generally abundant, much crowded, and always more or less symmetrically arranged. The skin consists of a layer of muscular fibres, covered by a tegumentary envelope or cutis, which is provided with an epithelium. The epithelium of the whole surface, not even excepting the pedial disc in the *Dorides*, and perhaps in the other members of the order, is provided with vibratile cilia. The dermal layer is thin and continuous with the inner or muscular layer, which is amply supplied with muscular fibres, principally longitudinal and transverse. Outside of, and amidst this muscular stratum, which is densest next the viscera, is the cell-work or system of dermal sinuses, through which the blood flows on its return to the heart.

The dermal layer appears to secrete the tenaceous fluid that so abundantly exudes from these animals; though that which lubricates the foot is probably provided by a special gland. The two large glands in *Fiona*, which lie beneath the stomach, and the ducts of which pass into the anterior margin of the foot, seem to be for this purpose. The so-called salivary glands of *Doto* are, in all likelihood, of a similar nature (see note, p. 12); and *Ægirus* has a glandular body placed transversely under the channel of the mouth, which appears to open externally in front of the crawling disc. *Goniodoris* is likewise furnished with a similar gland, less perfectly developed, and the thickened margin of the foot of *Polycera ocellata* contains numerous secreting follicles. The thickening of this margin, the transverse groove, and lateral prolongations, so common in these animals, are perhaps universally connected with the production and suffusion of the mucus over the pedial disc.

The cloak or mantle, which is characteristic of the *Dorididæ* and *Tritoniadæ*, and

which is present in a rudimentary state in the *Polycerinae* and a few of the *Eolididae*, is nothing more than a fold of the dorsal skin, and as such may be looked upon as representing the so-called organ in the testaceous gasteropods; though perhaps its true homologue exists in the side-lappets of the *Trochidae*; in which case these latter organs must be members of the dorsal skin, and not of the foot.

**HABITS.** As it is seldom possible to study these animals in their native haunts, the little that we know of their habits is mostly gathered from the observation of individuals kept in confinement, and consequently under influences more or less artificial.

Some of the species are nocturnal, but this is not the case with many of the littoral tribes. Such of these as are gregarious on small sea-weeds, as *Polycera quadrilineata*, may be observed in a state of activity during the day time, in tide pools left among the rocks, and apparently enjoying the warm rays of the sun. *Alderia modesta* has a similar habit in more shallow water, becoming almost amphibious; and *Doris bilamellata* is frequently found exposed on rocks left dry by the tide. But the greater number of the species avoid the light, concealing themselves under stones and shelving rocks. Most of the littoral tribes are found near to low-water mark; though some few kinds occur much higher up among the rocks, where they must remain several hours every tide deprived of water. *Doris pilosa*, *Eolis papillosa*, and *E. nana*, are generally met with in such situations; even the spawn of these species is frequently left dry by the receding tide.

The Nudibranchs partake largely of the sluggish character of the class to which they belong. This is more especially the case with some of the *Dorididae* and *Tritoniadae*, which will remain for hours fixed to a spot without apparent motion, and when roused from their torpor by the desire of food or some other stimulus, crawl slowly from place to place. Some of the *Polycerinae* are an exception to this rule, and many of the *Eolididae*, more especially those of our second section, are very active and lively in their movements. Dr. Johnston remarks respecting the Gasteropods generally, that the narrower and more elongated the foot, the quicker the motion, which becomes retarded just as that organ tends more to the oval or round. This observation holds good with respect to the Nudibranchs, if we except two or three genera in which the foot, from its extreme narrowness, is little fitted for progression. In these genera, as *Glaucus*, *Scyllæa*, and *Doto*, the foot is formed for clasping the stems of algæ or corallines, the sides being very thin and flexible, and capable of being brought together so as to embrace the stem: the foot can be completely flattened when applied to a plain surface. The *Eolides* with a very narrow foot move slowly on a flat surface, probably for the same reason.

Crawling is the usual mode of progression with these animals. This is effected in the manner of the snail, by a series of minute undulations of the under surface of the foot, arising from the alternate relaxation and contraction of the pedial muscles. None of our native species have the power of swimming freely through the water; and we are not aware of any means they have of reaching the surface but by crawling up any substance in contact with it. This they do frequently in confinement, by ascending the sides of the vessel, and then launching themselves, with outspread foot, on the surface of the water in an inverted position. Like most of the other aquatic gasteropods, they are very fond of floating in this way, which they do without any apparent effort. The mode of progression of the mollusca in this position has been the subject of some dispute, and it is undoubtedly somewhat obscure. In the opinion of M. de Quatrefages and some other naturalists, it is produced by the action of the vibratile

cilia which cover the surface of the body. Dr. Johnston objects to this, that it does not explain all the phenomena: for instance, "An *Eolis* crossing a basin can at once stop and remain there for some time; but during all this period of rest, the cilia are in as active a state as when the creature is in motion."\* This is undoubtedly the case, and would appear fatal to M. de Quatrefages' theory; and, moreover, the shell-bearing gasteropods are devoid of the same extent of ciliated surface, and yet they float with equal celerity. It has also been supposed that the undulating motion of the sides of the foot, acting against the water, is sufficient to account for the progression of the animal when floating, but this explanation appears equally unsatisfactory. We think, after carefully examining the subject, that this mode of progression is not very dissimilar from that of crawling. Whilst floating along the surface of the water, the sole of the foot is constantly undulating, as if moving upon the ground; and as a considerable quantity of mucus is always floating from it, the motion is probably produced by the undulations of the foot acting against this mucus, which forms a track on the surface of the water behind the animal. The inverted animal walks, as it were, along the floating mucus, much in the same way as it glides over the mucus which it sheds on its path when crawling; but in the latter case, the mucus, becoming adherent to the ground, enables the foot to act with greater effect than it can against the floating mucus: hence the animal can always crawl more quickly than it can float.

While floating in this manner the Nudibranchs occasionally drop suddenly down, suspending themselves from the surface by a thread of mucus, which is fixed to the tail or posterior extremity of the foot. In this way they will let themselves gradually down to the bottom, or remain some time pendant in the water without apparent support; for the thread of mucus is so transparent that it can scarcely be seen. When carefully looked for, however, it can always be perceived, originating in the track of mucus left on the surface by the animal; the mucus forming a small inverted cone at the point from which the thread issues, and here slightly dimpling the surface of the water. This thread of mucus must not be confounded with the byssus of the bivalves. Some of the species also occasionally suspend themselves from the surface of the water by the hind part of the foot, which for this purpose is expanded into a disc, and from this, as a fixed point, the body is suspended and moved about at the will of the animal. In this case the floating mucus is the fulcrum to which the hind part of the foot is attached.

On any of these occasions, either when floating or when suspended, if alarmed, the animal falls at once to the bottom. This is effected by the foot quitting its hold of the mucus, when the animal, being specifically heavier than the water, of course sinks: its specific gravity is, no doubt, increased by the collapse of the parts; but the Nudibranchs are never lighter than the water, even when fully expanded, though in this state many of them are nearly buoyant.

We have seen *Dendronotus arborescens* float for a considerable time in the middle of the water without any apparent connexion with the surface. This comes nearest to the act of swimming that we have observed in any of the native species. Some foreign genera, however, can swim freely through the water in any direction. *Tethys* and *Melibe* are stated by M. Sander Rang to do this by means of the large veil with which they are furnished, assisted by the undulating motion of the posterior part of the body; and the same means of progression

\* 'Introduction to Conchology,' p. 130.

has been more fully described by the Rev. R. T. Lowe in his very curious genus *Peplidia*,\* found on the shores of Madeira. Mr. Lowe's graphic description is of so much interest that we are induced to give an extract of it. "In a glass of sea-water in which this animal lived for more than six weeks, it had the usual habits of a *Doris*, but with more activity: swimming about violently when disturbed or when provided with a fresh supply of water, in which operation the hind part of the body, with the crested fin-like tail, is lashed from side to side with a strong and regular sculling motion; the fore-part, with the head or veil expanded to its full dimensions, being at the same time beat with equal force and regularity in a contrary direction, or obliquely upwards and downwards, stroke for stroke; these parts (the veil and crest) performing thus alike the office of true fins. At night, especially when thus in motion, it appeared most brilliantly phosphorescent; the light flashing progressively but very rapidly along the body, especially from all the branchial tufts and the edges of the veil and crest. At other times it remained quiescently adhering to the sides of the glass, or moving slowly up and down, as if in search of food; seeming to use the veil as a feeler, but with the tentacles reflected. Sometimes it crawled in the usual inverted position along the surface of the water." "Its mode of swimming perfectly resembles that of the larva of the gnat so common in our English cisterns of rain-water."† This is the only account of the phosphorescence of the Nudibranchs that we recollect to have seen.

The Nudibranchiate Mollusca are very sensitive to external influences, shrinking quickly from contact, and withdrawing their organs on the least sense of danger. When crawling on sea-weeds or corallines, they often detach themselves on being disturbed, and drop to the bottom of the water. The *Eolides*, when alarmed or irritated, erect their papillæ, and sometimes agitate them in a convulsed manner, directing their apices to any source of annoyance; each papilla being endowed with a motion independent of the others. On such occasions urticating filaments are probably ejected from the tips of these organs. We once had an opportunity of observing fluid emitted from the papillæ of *Eolis picta*. While watching this species, with the aid of a powerful lens, as it was moving about in a small vessel of water, the animal became suddenly alarmed, raising and twitching its papillæ, which at the same instant gave out from their apices minute streams of a milk-white fluid; these curling upwards were dissipated in the surrounding medium, and there can be little doubt contained urticating bodies, which the papillæ always eject on slight pressure. The papillæ of *Eolis*, *Doto*, *Antiopa*, and some other allied genera, are very slightly attached to the back, and the animals appear to have the power of casting them off voluntarily, in the same manner as a crab throws off its claws, or a star-fish its arms. We have frequently found an *Eolis* or an *Antiopa* that had been injured in capture, or placed in sea-water that was a little impure, throw off the whole of its branchiæ in a very short time. It is curious to see the papillæ on such occasions swimming through the water like independent worms, propelled by the vibratile cilia, and occasionally by a convulsive motion of the muscles, which do not lose their vital power quite immediately. The organs thus cast off are quickly reproduced when the animal is in a healthy state; and what seems strange is that, in the mean time, it does not appear to suffer any inconvenience from the loss of these, as might have been supposed, vital organs. Even when they are all

\* This genus we take to be synonymous with *Plocamopherus* of Ruppell.

† 'Ann. Nat. Hist.,' v. 11, p. 311.

removed the animal will crawl about in perfect unconcern; and in this state they have been observed to copulate. The power of renewing lost or injured parts is enjoyed by these little Mollusks in common with the rest of the class, and it is interesting to observe the progress of their growth, which may readily be done when the animals are kept in a glass vessel. In an *Eolis* so confined, and in a great measure deprived of food, we have seen the papillæ reappear and attain a considerable size in three or four days. At first they resemble tubercles, without central gland, which, however, soon makes its appearance, and assumes its normal character.

Their tenacity of life when kept in confinement varies much in the different species, but is greater than in many other marine animals. Any impurity in the water, or too great change of temperature, affects them very sensibly, so that it is difficult to keep them alive in warm weather, particularly those from deep water. The littoral species can sustain a greater change of temperature, and may be kept alive for a considerable time out of water in a moist saline atmosphere, but they die almost immediately when deprived of moisture. Their power of enduring abstinence is remarkable. We have kept them for weeks, and even months, without food, and have observed little diminution of their vital energy. In such cases they generally lose a good deal of colour and become very transparent.

But, though so patient and long-suffering in the endurance of hunger, these little animals are very voracious. The greater number of them are carnivorous; living principally upon zoophytes and sponges. The *Alcyonium digitatum* is a favorite food with the *Tritoniæ*; and the *Actiniæ* and *Lucenariæ* often fall a prey to the attacks of the *Eolides*. These latter, indeed, do not scruple occasionally to devour the weaker among their own brethren, as we have elsewhere recorded. Sir J. G. Dalyell states that his *Eolis histriæ* (*Drummondi*) "fed voraciously on mussel, and on the common periwinkle, whereof large portions were swallowed entire;" and he thinks that *Goniodoris nodosa* feeds upon *Ascidia papilla* (*Cynthia rustica*), to which he attributes the reddish colour observed in the viscera. This colour, however, is caused by the liver and ovary. We have taken from the stomach of *Eolis papillosa* minute specimens of the common mussel, and a small *Terebra* from that of *Tethys*. The more common food of the tribe, however, is the flexible zoophytes. Until lately the *Dorides* have been considered vegetable feeders, but this would appear not to be the case. *Doris tuberculata* feeds upon the common encrusting sponge (*Halichondria panicea*), and sponges and zoophytes seem to constitute the food of most of the others. A few of the gregarious Nudibranchs, such as *Polycera quadrilineata*, *Hermæa dendritica*, and *Alderia modesta*, which congregate on marine algæ, appear to be phytivorous; but *Eolis despecta*, and *E. exigua*, though not unfrequently gregarious on the fronds of *Laminaria digitata*, are only found on those parts of the plants that are covered with the parasitic zoophytes, *Laomedea geniculata* and *L. gelatinosa*, on which they feed and deposit their spawn.

Most of the species that are found between tide-marks make their appearance periodically, and the common kinds are generally found in considerable numbers for a time, extending from one to three months, after which they almost entirely disappear. This is their breeding season, and it is generally considered that these animals live mostly beyond low-water mark for a great part of the year and come into shallower water to spawn, as is the case with several tribes of marine animals. This opinion, however, does not accord with what is known of the habits of other Mollusks. It is not likely that creatures so defenceless and limited in locomotive

powers as the Nudibranchs should be ordained to make perilous migrations, while the well protected testaceous gasteropods are permitted to enjoy a sedentary existence. The latter might roam about in comparative security; and, indeed, trusting to their shelly covering, they do boldly expose themselves on rocks and sea-weeds. The Nudibranchs, on the contrary, avoid the light, their nakedness compelling them to seek concealment in crevices of rocks and under stones, where they probably pass the whole of their lives; and being thus, as it were, confined to a spot, their dissemination is provided for by the natatory condition of the larvæ; without which provision these animals would probably be extremely local. The way in which the species are distributed between tide-marks is also unfavorable to the notion of migration; as most of them inhabit well defined zones or belts on the beach, beyond which they are rarely found.

The periodical appearance of the Nudibranchs within tidal range admits of another and more satisfactory explanation; namely, that these animals, whose period of life is probably short, may not live longer than a year, and that most of the old individuals die off after the breeding season, and the young fry, being for many months afterwards small and inconspicuous, escape observation, attaining maturity only a short time before the next breeding season, when, having given birth to a new progeny, they die and disappear in their turn. Whatever be the cause, the various species generally do disappear from the rocks shortly after their respective breeding seasons, though for some months afterwards solitary individuals occur. In the course of two or three months the fry may be detected if closely looked for, and afterwards their development noted until they reach maturity and shed their spawn in the same localities that were occupied by their parents. We have in this way traced the development of *Goniodoris nodosa* throughout the year, and can vouch for its attaining its full growth in twelve months, as, indeed, is evident enough in most of the common rock species. It is true that the disappearance of the adult individuals after spawning may be accounted for by their retiring into deeper water; but, in this case, we might expect to be able to trace their change of place on the shore at different seasons; besides that, several of the most abundant littoral species are scarcely, if ever, brought up by the dredge, and certainly never in such numbers as to warrant the conclusion of their living for the greater part of the year below low-water mark. Some of the species are to be found within tide-marks during the whole year, though most plentifully in the breeding season. Such species most probably live longer than one year. Other species, again, are taken within tidal range for a year or two, and then disappear from the locality for a long period. Some of these species appear to belong to deep water, and their accidental occurrence on the rocks may arise from the agency of currents sweeping the natatory larvæ beyond the limits of their proper zone.

Not much is known concerning the longevity of the Nudibranchs, but if the opinion we entertain respecting the periodical appearance of these Mollusks on the rocks be correct, it is evident that the period of existence of numerous species must be short,—not much exceeding a year. And, judging from the rapidity of their growth, and their great fecundity, compared with the few individuals that are found in a mature state, it may be inferred that such is correct. In some of the species, however, individuals of overgrown size and venerable appearance may be met with that might be supposed to have lived through many summers. M. Bouchard Chantreaux states that *Eolis Cuvieri* (*papillosa*) does not acquire its full growth till the end of

the second year; and M. Nordmann thinks that his *Tergipes Edwardsii* lives at least two years. The period will, no doubt, vary in different genera and species, though in none is it perhaps much extended.

The Nudibranchs, notwithstanding that they are androgynous, frequently copulate during the breeding season. The conjoined individuals lie side by side, their heads turned in opposite directions. Thus the right sides of the two animals are brought into close contact, and mutual impregnation is effected. They remain in this position for some time, and in a short period after separating, generally about the first or second day, the spawn is deposited. This is usually adherent to some foreign body, and on expulsion from the animal is enveloped in a perfectly transparent mucus, which at first is tenacious, having the property of adhering to whatever it comes in contact with; but the surrounding water soon destroys this quality, and, to some extent, hardens it. By means of this mucus, the spawn becomes at once glued, as it were, to the surface of whatever substance the animal may happen to be resting upon. While shedding the spawn it slowly and gradually moves backwards in a spiral direction, beginning in the centre; thus the spawn assumes the spiral form, coiling in the usual way from right to left. Occasionally, it is found coiled in a contrary direction, in which case the animal must crawl forward during the propulsion of the spawn.\* The spiral form is the most perfect when the animal is resting upon a flat surface: on corallines, for want of an expanded support, it necessarily becomes more irregular. The form and caliber of the sexual aperture and the even or interrupted propulsion of the spawn, combine in different degrees with internal organic causes, to form those peculiar and elegant patterns which characterise the different species. When the spawn is shed freely and at once, the masses assume an oval or kidney shape; but a more slow and gradual propulsion results in its taking a spiral form from the causes already named.

The time required for the maturity of the embryo after the deposition of the spawn varies in different species, and under different circumstances, from a few days to a month or more; the usual time appears to be about ten days or a fortnight. The extraordinary difference between the minute natatory larva in its first state of existence and the adult animal, has been fully described in another part of this work.† That a minute creature, scarcely visible to the naked eye, enclosed in an operculated shell, and swimming freely through the water by means of ciliated lobes, should turn into the large and sluggish *Doris tuberculata* or *Tritonia Hombergii*, is one of nature's romances, only to be learnt from a careful study of her works. Unfortunately, though their development from the spawn can readily be traced, naturalists have not hitherto succeeded in preserving these delicate little creatures alive for more than a few days, so that the progress of their change into the perfectly formed animal has not been traced in detail. Thousands, no doubt, perish at an early stage, or become the prey of other marine animals. The accidents to which they are liable, or the occurrence of circumstances favorable to their preservation and diffusion, may readily account for the occasional appearance and disappearance of some species in a manner apparently, at first sight, somewhat arbitrary.

\* The figures of the spawn in different works, in consequence of the inattention of the engravers, are often reversed, and cannot be relied upon.

† See the genus *Doris*, anatomy and development.

Monstrosities, or sports of nature, are occasionally found amongst the *Nudibranchiata*. Mr. Peach sent us from Peterhead an *Eolis papillosa*, in which there was only one dorsal tentacle, placed in the centre of the head. Sir J. G. Dalyell figures the tentacles of an *Eolis*, which he calls *E. monoceros*, from the circumstance of its having a single forked dorsal tentacle. "A pillar," he says, "rises from the middle of the neck, which diverges into two cornicula, with about seven whorls on each." It was probably a monstrosity of *E. coronata*. In both these instances, the peculiarity appears to arise from the complete or partial fusion of the two tentacles into one. The latter author also figures a mal-formation of *Doto fragilis* (called *Tritonia conifera*) with "a large central branchial tuft on the back between the two branchiæ of the third pair." We have seen *Eolis rufibranchialis* with one of the dorsal tentacles bearing a lateral branch; and have observed a similar sport of nature in the branchial papillæ of *E. alba* and several other species. More frequently, however, the variations consist of the suppression of less important parts, to which some species are more liable than others. *Polycera quadri-lineata* is extremely variable in this respect; the velar filaments, the rows of tubercles, and the branchial appendages being alike subject to variation in this species.

PARASITES.—The Nudibranchs are frequently infested with parasitical *Entomostraca*, which are usually buried beneath the skin, the ovigerous vesicles only appearing outside; but occasionally they penetrate into the abdominal cavity, or live freely on the surface. We have observed several species of these parasites inhabiting the *Dorididæ* and *Eolididæ*.

*Tethys* is liable to be thus annoyed by a large kind; an individual so affected is figured in Delle Chiaje's Memoirs, (copied in Mrs. Gray's 'Figures of Molluscous Animals,' pl. 210, fig. 1). A small species is occasionally found on some of the *Eolides* and on *Doto coronata*. In two or three specimens of *Eolis rufibranchialis* which occurred near Whitley, two irregularly formed elliptical lobes, the ovigerous sacs of this species, protruded from the skin between the tentacles. The *Eolides* were apparently quite healthy, and evinced no suffering, notwithstanding that the parasites must have been lodged in the vicinity of the cephalic ganglions. The lobes were very dense, pale flesh-coloured, and exhibited a minute granular appearance. The second day after their capture the lobes disappeared, and in the course of an hour or two they were replaced by others, in which the granular appearance was very indistinct. Unfortunately, we have not been able to examine the body of this animal sufficiently to give a description of it. Two very curious forms, however, have occurred in some specimens of *Doris pilosa* from Devonshire, to which we have paid more attention. Both these were found within the abdominal cavity resting upon the liver-mass. One (Pl. 45, figs. 6, 7) is nearly a quarter of an inch long, with a narrow, linear, soft body, of a white colour, without segments, and having the tail or abdomen tapering a little, and apparently composed of two or three articulations. This extremity is always attached to the skin within the branchial circle of the *Doris*, where the ovigerous lobes were most likely protruded. These, however, we have not seen; though in one specimen, what appeared to be the remains of them, were still adhering to the tail. There are three pairs of legs from the sides of the body, which are long, tapering, soft, and without articulations; they lie closely embracing the liver-mass. The mouth is situated below in front, and is apparently without appendages.

We have never found more than one individual of this strange form inhabiting the same *Doris*; and with it there were always associated one, two, or three of the other species before



alluded to. This latter (Pl. 45, figs. 8, 9,) is about one sixteenth of an inch in length, depressed, with the thoracic shield quite distinct from the abdomen, and composed of only one segment, of an irregular oval or sub-quadrilateral form, broadest behind: a projection in front covers the head. The abdomen is narrow; it tapers a little, and is formed of four or five segments. The tail is bilobed, each lobe bearing a single stout hair. The mouth is situated below, and has on each side a hook, supported on a flexible base; the head is likewise furnished with a pair of articulate antennæ. There are three pairs of rather feeble thoracic feet, the last articulation bearing a slender hook.

Whether these two forms are distinct species, which from their great dissimilarity might be supposed to be the case, or are the opposite sexes of the same species, cannot at present be determined; but their constant association together would seem to point to the latter conclusion.

We have taken another interesting species (Pl. 45, fig. 10) on *Doris tuberculata*, adhering to the branchiæ. It is not, however, confined to these organs, but ranges over the whole surface of the body. It is minute, measuring scarcely one sixteenth of an inch long, is almost colourless, depressed, ovate, the broad end forward. The thorax is composed of four segments, the first being very large; the other three narrow. The abdomen is small, and formed of four or five segments, the first two being larger than the rest and not very distinctly separated. The tail is bilobed, each lobe bearing five setæ, two of which are very long. There are four pairs of feet, three of which belong to the thorax: these are composed of several joints, each, excepting the last, bearing a single spine; the last joint is flattened and has on its inner margin several setæ, on the exterior margin three spines. The fourth pair of feet are rudimentary; they belong to the first segment of the abdomen, and are formed of one joint, bearing at its extremity two setæ. The antennæ are long, slender, and composed of several setose articulations. Immediately behind these, there are a pair of stout arms or feet, formed of three joints, the last being furnished with two hooks. The eye is deep rose-coloured. The ovigerous lobes are yellowish-white, of a cylindrical form with the ends rounded; the eggs are large, and not very numerous.

Drawings of the above three forms have been submitted to Dr. Baird, who kindly informs us that the last-mentioned species belongs to the genus *Ergasilus*, and he has no doubt that it is perfectly new and undescribed. The same naturalist also states that the small form from *Doris pilosa* very possibly belongs to the genus *Bomolachus*; but that it appeared to be imperfectly developed. It is also new to him, and very different from any species with which he is acquainted.

We have seen another species of *Ergasilus*. This was taken on *Antiopa cristata* from the south of England, and had deep orange-coloured ovigerous lobes.

These ovigerous vesicles of the parasitic *Entomostraca* have sometimes been described and figured as a part of the animals in which they were found.

**DISTRIBUTION.** With the imperfect knowledge of foreign species that we yet possess, it is scarcely possible to arrive at any satisfactory conclusion concerning the general distribution of the *Nudibranchiata* in the different regions of the globe. So far as the observations of travellers go, they appear to be pretty generally diffused throughout all seas and in all climates. The tropical forms are, as usual, larger and more brilliantly coloured than those of

colder climates, but the notices of extra-European species are so scanty that we cannot form any idea of their numerical preponderance, nor can we, for the same reason, point out, as may be done in many groups of animals and plants, any particular centres of distribution where they are more especially congregated. With the exception of a few oceanic wanderers, such as *Glaucus* and *Scyllæa*, which have been met with by almost every voyager, nearly all the Nudibranchs that have been described by naturalists visiting the southern hemisphere belong to the *Dorididæ*; and these show a much greater variety of forms than are to be found in the same family with us. It may, therefore, be inferred that the members of this family are proportionally more numerous in warm climates than in the more northern and colder regions; but were we to take the number of species at present known as a ratio of their preponderance, we should certainly be very wide of the mark, for it cannot be doubted that a great deal of the apparent deficiency of other genera, in comparison with the *Dorididæ*, in foreign countries, arises from the want of proper examination, and from the little attention paid by collectors to the less conspicuous forms. It may therefore be expected that when naturalists visiting foreign countries shall have their attention directed more especially to this beautiful race of marine animals, they will not only collect those conspicuous species which, from their size and colour, obtrude themselves upon the eye, but will search out in their hidden retreats the smaller, and often more interesting because more varied, forms that belong to the other families. We cannot doubt that a rich harvest is yet in store for future voyagers in this department of natural history.

To show the futility of founding generalisations upon imperfect data, we may mention that in a report on the distribution of this order formerly published, we stated on the authority of existing works, that the *Dorididæ* of the Mediterranean greatly exceeded the *Eolididæ* in number, and that the latter were not only few but of small size compared with those of colder climates. The more recent Catalogue of the Mollusca of the Gulph of Genoa, by M. Verany, however, contains a greater number of species belonging to the latter family than to the former, and we find the average size is in fact greater in the Mediterranean *Eolides* than in those of our own shores. But, making every allowance for errors, there still exists a greater proportion of *Eolididæ* in the seas of northern Europe, so that our former inference that *Eolis* is a northern type of form is probably correct. A comparison of the British and Mediterranean Nudibranchs shows that not more than five species have been ascertained to be common to both localities. These are *Antiopa cristata*, *Goniodoris castanea*, *Polycera quadrilineata*, *Idalia elegans*, and *Doto coronata*; others that have been described under the same name are certainly distinct, and even those we now mention are not all quite free from doubt.

The few species that are yet recorded as inhabitants of the seas of North America come much nearer to the British forms. Two of them, *Dendronotus Reynoldsii* (*arborescens*) and *Polycera illuminata* (*Lessonii*), appear to be identical, and some others are probably so. It is only on the Atlantic shores of Europe, however, that we find any considerable number of species similar to our own. But here again the want of sufficient data prevents our entering upon any exact analysis. The French coast has been very imperfectly explored, and those of Spain and Portugal are, in this respect, nearly a complete blank. The species found in the north of France, on the borders of the British Channel, are, with one or two exceptions,

similar to what are found on the opposite coast of England. Concerning the shores of Holland and western Germany, our information is very scanty, but as they are generally low and sandy, the Nudibranchs found on them are probably few. Those of Bommé's species that have been recognised are identical with our own. As we approach the north of Europe our information concerning these animals becomes more extensive. At least two thirds of the species in the Scandinavian fauna agree specifically with those of Britain, and, when both countries are more completely searched, it is not unlikely that this agreement may be found yet more intimate.

The distribution of the British species will be best understood by an examination of the following tables, in which we have endeavoured to condense all the information on the subject we at present possess.

It has been considered sufficient, in the table of Geographical Distribution, to adopt the natural and obvious division of the shores of the British Islands into three regions—southern, eastern, and western—forming the three sides of a triangle whose apex is the north. The northern forms may by this means be somewhat divided; but this division is naturally suggested by the form of the coast line, and we the more willingly adopt it, as so little is known of the littoral Nudibranchs inhabiting the extreme north-western shores. The true northern marine fauna of our Islands will be found on the north-eastern coast, extending from Shetland to the Humber; a circumstance arising from the set of the tide from the north in that direction. Scarcely anything is known of our Mollusca from the Humber to the Straits of Dover. Properly speaking, therefore, the three known divisions of our shores resolve themselves into the southern, the western, and the north-eastern. The southern coast is the richest in specific and generic forms, more especially the latter. Seven genera inhabiting the southern and western coasts are not found on the eastern: these are *Thecacera*, *Scyllæa*, *Lomanotus*, *Fiona*, *Alderia*, *Antiopa*, and *Proctonotus*. Not a single genus of the latter division, however, is absent in the other two, though *Embletonia* ought perhaps to be considered a northern form. As has been observed in other departments of the Mollusca, the southern species extend much further northward on the western shores of Great Britain than on the eastern. This arises from the set of the currents on that side of the island in a northerly direction; and the influence of the Gulph Stream on the western shores of Ireland and Scotland seems to have a similar effect. On this account probably it is that two or three species inhabiting our southern and western shores, though not found on the east coast, make their appearance again on the western shores of Norway.

In the table of distribution according to zones of depth, we have adopted the three great divisions of littoral, coralline, and deep-water. The laminarian zone, extending from low-water mark to a few fathoms in depth, we consider to be a sub-region belonging to the littoral, and characterised mainly by the same species, nearly all the inhabitants of the Laminarian zone being occasionally found within tide-marks. The two together constitute the region of sea-weeds or *Algæ*. It would be easy to subdivide this region into smaller zones, each characterised by one or two particular species, but we have thought it unnecessary to do so in the present instance. The limits of each species, as far as they have been ascertained, are mentioned in the specific descriptions. A glance at the table will show that the greatest number of species is to be found in the littoral zone; though the number

inhabiting the coralline region (or region of flexible zoophytes) is not very far inferior. Beyond this region the Nudibranchs to be met with are few, and chiefly belong to the genera *Tritonia* and *Idalia*. Several species are common to the littoral and coralline zones, but only one, *Doto coronata*, has yet been found to inhabit all the three regions. Nearly all the *Dorididae* (*Idalia* excepted) are littoral, a very few only reaching to the coralline zone. The *Eolides* are pretty nearly divided between the two.

## NUMBER OF SPECIES IN EACH GENUS.

DORIDIDÆ.			
Doris	.	.	21
Goniodoris	.	.	2
Triopa	.	.	1
Ægirus	.	.	1
Thecacera	.	.	3
Polycera	.	.	3
Ancula	.	.	1
Idalia	.	.	6
			38
TRITONIADÆ.			
Tritonia	.	.	4
Scyllæa	.	.	1
			5
EOLIDIDÆ.			
Lomanotus	.	.	2
Dendronotus	.	.	1
Doto	.	.	3
Eolis	.	.	41
Embletonia	.	.	3
Fiona	.	.	1
Hermæa	.	.	2
Alderia	.	.	1
Proctonotus	.	.	1
Antiopa	.	.	2
			57
			100

## GEOGRAPHICAL DISTRIBUTION.

	N.E.	W.	S.		N.E.	W.	S.
<i>Doris tuberculata</i> . . . . .	×	×	×	<i>Eolis glauca</i> . . . . .	.	×	×
<i>flammea</i> . . . . .	.	×	.	<i>Alderii</i> . . . . .	.	.	×
<i>Zetlandica</i> . . . . .	×	.	.	<i>coronata</i> . . . . .	×	×	×
<i>millegrana</i> . . . . .	.	.	×	<i>Drummondi</i> . . . . .	×	×	×
<i>planata</i> . . . . .	.	×	.	<i>punctata</i> . . . . .	.	.	×
<i>Johnstoni</i> . . . . .	×	×	×	<i>elegans</i> . . . . .	.	.	×
<i>coccinea</i> . . . . .	.	.	×	<i>rufibranchialis</i> . . . . .	×	×	.
<i>repanda</i> . . . . .	×	×	.	<i>lineata</i> . . . . .	.	×	.
<i>aspera</i> . . . . .	×	?	.	<i>smaragdina</i> . . . . .	×	.	.
<i>proxima</i> . . . . .	.	×	.	<i>gracilis</i> . . . . .	×	×	.
<i>muricata</i> . . . . .	.	×	.	<i>pellucida</i> . . . . .	×	.	.
<i>Ulidiana</i> . . . . .	.	×	.	<i>Landsburgii</i> . . . . .	×	×	×
<i>diaphana</i> . . . . .	.	.	×	<i>alba</i> . . . . .	×	×	×
<i>oblonga</i> . . . . .	.	.	×	<i>carnea</i> . . . . .	.	.	×
<i>bilamellata</i> . . . . .	×	×	×	<i>Glaucoides</i> . . . . .	.	.	×
<i>depressa</i> . . . . .	×	×	×	<i>Peachii</i> . . . . .	×	.	×
<i>inconspicua</i> . . . . .	×	.	.	<i>nana</i> . . . . .	×	.	.
<i>pusilla</i> . . . . .	×	.	×	<i>stipata</i> . . . . .	.	.	×
<i>sparsa</i> . . . . .	×	.	.	<i>angulata</i> . . . . .	×	.	.
<i>pilosa</i> . . . . .	×	×	×	<i>inornata</i> . . . . .	.	.	×
<i>subquadrata</i> . . . . .	.	×	×	<i>concinna</i> . . . . .	×	.	.
<i>Goniadoris nodosa</i> . . . . .	×	×	×	<i>olivacea</i> . . . . .	×	×	×
<i>castanea</i> . . . . .	.	×	×	<i>aurantiaca</i> . . . . .	×	×	×
<i>Triopa claviger</i> . . . . .	×	×	×	<i>pustulata</i> . . . . .	×	.	.
<i>Ægirus punctilucens</i> . . . . .	×	×	×	<i>Couchii</i> . . . . .	.	.	×
<i>Thecacera pennigera</i> . . . . .	.	.	×	<i>amœna</i> . . . . .	.	.	×
<i>virescens</i> . . . . .	.	.	×	<i>Northumbria</i> . . . . .	×	.	.
<i>capitata</i> . . . . .	.	.	×	<i>arenicola</i> . . . . .	.	×	.
<i>Polycera quadrilineata</i> . . . . .	×	×	×	<i>Glottensis</i> . . . . .	.	×	.
<i>ocellata</i> . . . . .	×	×	×	<i>viridis</i> . . . . .	.	×	×
<i>Lessonii</i> . . . . .	×	×	?	<i>purpurascens</i> . . . . .	×	.	.
<i>Ancula cristata</i> . . . . .	×	×	×	<i>cingulata</i> . . . . .	×	.	.
<i>Idalia elegans</i> . . . . .	.	.	×	<i>vittata</i> . . . . .	×	.	.
<i>Leachii</i> . . . . .	×	×	×	<i>cœrulea</i> . . . . .	.	.	×
<i>aspersa</i> . . . . .	×	×	.	<i>exigua</i> . . . . .	×	×	×
<i>inæqualis</i> . . . . .	×	.	.	<i>picta</i> . . . . .	×	×	×
<i>pulchella</i> . . . . .	.	.	×	<i>tricolor</i> . . . . .	×	×	×
<i>quadricornis</i> . . . . .	.	.	×	<i>amethystina</i> . . . . .	×	.	.
<i>Tritonia Hombergii</i> . . . . .	×	×	×	<i>Farrani</i> . . . . .	×	×	.
<i>alba</i> . . . . .	×	.	.	<i>despecta</i> . . . . .	×	×	×
<i>plebeia</i> . . . . .	×	×	×	<i>Embletonia pulchra</i> . . . . .	.	×	.
<i>lineata</i> . . . . .	×	.	.	<i>minuta</i> . . . . .	×	.	.
<i>Scyllæa pelagica</i> . . . . .	.	.	×	<i>pallida</i> . . . . .	.	×	.
<i>Lomanotus marmoratus</i> . . . . .	.	.	×	<i>Fiona nobilis</i> . . . . .	.	.	×
<i>flavidus</i> . . . . .	.	×	.	<i>Hermæa bifida</i> . . . . .	×	×	×
<i>Dendronotus arboreescens</i> . . . . .	×	×	×	<i>dendritica</i> . . . . .	.	.	×
<i>Doto fragilis</i> . . . . .	×	×	×	<i>Alderia modesta</i> . . . . .	.	×	×
<i>pinnatifida</i> . . . . .	.	.	×	<i>Proctonotus mucroniferus</i> . . . . .	.	×	.
<i>coronata</i> . . . . .	×	×	×	<i>Antiope cristata</i> . . . . .	.	×	×
<i>Eolis papillosa</i> . . . . .	×	×	×	<i>hyalina</i> . . . . .	.	×	.

A MONOGRAPH OF THE  
DISTRIBUTION IN ZONES OF DEPTH.

## 1. LITTORAL ZONE.

## 2. CORRALINE ZONE.

## 3. DEEP-WATER OR CORAL ZONE.

	1	2	3		1	2	3
Doris tuberculata . . . .	×	.	.	Eolis glauca . . . .	×	×	.
flammea . . . .	×	×	.	Alderi . . . .	×	.	.
Zetlandica . . . .	×	?	.	coronata . . . .	×	×	.
millegrana . . . .	×	?	.	Drummondi . . . .	×	×	.
planata . . . .	×	.	.	punctata . . . .	.	×	.
Johnstoni . . . .	×	.	.	elegans . . . .	.	×	.
coccinea . . . .	×	.	.	rufibranchialis . . . .	×	×	.
repanda . . . .	×	.	.	lineata . . . .	×	×	.
aspera . . . .	×	.	.	smaragdina . . . .	×	.	.
proxima . . . .	×	.	.	gracilis . . . .	×	×	.
muricata . . . .	×	.	.	pellucida . . . .	.	×	.
Ulidiana . . . .	×	.	.	Landsburgii . . . .	×	×	.
diaphana . . . .	×	.	.	alba . . . .	×	×	.
oblonga . . . .	×	.	.	carnea . . . .	.	×	.
bilamellata . . . .	×	.	.	Glaucoides . . . .	×	.	.
depressa . . . .	×	.	.	Peachii . . . .	.	×	.
inconspicua . . . .	.	×	.	nana . . . .	×	.	.
pusilla . . . .	×	.	.	stipata . . . .	.	×	.
sparsa . . . .	.	×	.	angulata . . . .	.	×	.
pilosa . . . .	×	?	.	inornata . . . .	×	.	.
subquadrata . . . .	×	.	.	concinna . . . .	×	.	.
Goniodoris nodosa . . . .	×	.	.	olivacea . . . .	×	×	.
castanea . . . .	×	.	.	aurantiaca . . . .	×	×	.
Triopa claviger . . . .	×	×	.	pustulata . . . .	.	×	.
Ægirus punctilucens . . . .	×	.	.	Couchii . . . .	×	.	.
Thecacera pennigera . . . .	×	.	.	amœna . . . .	.	×	.
virescens . . . .	×	.	.	Northumbria . . . .	.	×	.
capitata . . . .	.	×	.	arenicola . . . .	.	×	.
Polycera quadrilineata . . . .	×	?	.	Glottensis . . . .	.	×	.
ocellata . . . .	×	.	.	viridis . . . .	×	×	.
Lessonii . . . .	.	×	.	purpurascens . . . .	×	.	.
Ancula cristata . . . .	×	.	.	cingulata . . . .	×	.	.
Idalia elegans . . . .	.	×	.	vittata . . . .	.	×	.
Leachii . . . .	.	×	×	cœrulea . . . .	×	.	.
aspera . . . .	.	×	.	exigua . . . .	×	.	.
inæqualis . . . .	.	.	×	picta . . . .	×	×	.
pulchella . . . .	.	×	.	tricolor . . . .	.	×	.
quadricornis . . . .	.	×	.	amethystina . . . .	×	.	.
Tritonia Hombergii . . . .	.	×	×	Farrani . . . .	×	×	.
alba . . . .	.	×	.	despecta . . . .	×	.	.
plebeia . . . .	.	×	.	Embletonia pulchra . . . .	×	.	.
lineata . . . .	×	.	.	minuta . . . .	.	×	.
Scyllæa pelagica . . . .	.	.	×	pallida . . . .	×	.	.
Lomanotus marmoratus . . . .	.	×	.	Fiona nobilis . . . .	×	.	.
flavidus . . . .	.	×	.	Hermæa bifida . . . .	×	×	.
Dendronotus arborescens . . . .	×	×	.	dendritica . . . .	×	.	.
Doto fragilis . . . .	.	×	×	Alderia modesta . . . .	×	.	.
pinnatifida . . . .	.	×	.	Proctonotus mucroniferus . . . .	.	×	.
coronata . . . .	×	×	×	Antiope cristata . . . .	×	×	.
Eolis papillosa . . . .	×	?	.	hyalina . . . .	×	.	.

**ALLIANCES.** At first sight the Nudibranchiate Mollusca appear to be a peculiar and well-marked group, possessing characters that readily distinguish them from all the other orders of *Gasteropoda*.<sup>\*</sup> A closer examination, however, shows that this is not the case. The *Nudibranchiata*, though displaying in their typical forms a striking and well recognised character, pass so gradually and almost imperceptibly into the neighbouring groups, as to give rise to considerable difference of opinion on the limits of the order, and the genera which should be included in it. In the present work, the order *Nudibranchiata* is restricted to those forms with well-marked external branchiæ which constitute the original *Nudibranches* of Cuvier. The anatomical researches of later times have, however, shown so great a similarity in the internal structure between these, and a small group of Mollusks, until lately nearly overlooked, and the extent of which is still imperfectly known—our order *Pellibranchiata*, and the *Enterobranches remibranches* and *Dermobranches* of Quatrefages—that an opinion is gaining ground favorable to their constituting an aberrant group of the order *Nudibranchiata*. The point of union between these two groups is found in the genus *Elysia* (*Actæon* of Oken), many of whose characters approach very closely to those of *Hermæa*. In their external form the principal difference consists in the want of distinct branchiæ in *Elysia*, their place being supplied by the extension of the sides of the back into longitudinal flaps or folds, that, physiologically considered, may be supposed to represent the branchial papillæ fused into a single organ on each side. The head and tentacles in *Elysia* are similar to those of *Hermæa*, and internally we perceive the same character of tongue and digestive organs, including a highly ramified gastro-hepatic apparatus, which, in this genus, is probably carried to its greatest degree of divisibility. The reproductive organs are also similar in both genera, if it may be assumed that they are formed in *Hermæa* on the type of those in *Calliopæa* (*Stiliger*), of which there can be little doubt. *Elysia* has been considered by some authors to be a pulmoniferous Mollusk, but this appears to be a mistake. With the exception of *Placobranchus*, a genus very imperfectly known, the other Pellibranchs approach less nearly to the true Nudibranchs in their external characters, though they retain considerable resemblance in their internal organisation. *Phyllirrhoe*, a genus united to the *Nudibranchiata* on account of its anatomical characters, by M. Souleyet and Dr. Gray, is a remarkably anomalous and aberrant form, possessing scarcely any external appearance of relationship with this order.

On the other hand, the Nudibranchs show several points of affinity with the *Tectibranchiata* and *Inferobranchiata* of Cuvier, especially with the latter, two genera of which approach very closely to the Nudibranchiate type. These are *Phyllidia* and *Diphyllidia*, both included in this order by M. D'Orbigny and Dr. Gray. In the former genus we find a pustulated or corrugated cloak covering the animal, and pierced, as in *Doris*, for the protrusion of the dorsal tentacles and the anus. Like the *Dorididæ*, too, this genus exhibits a character very peculiar among the Mollusca, that of having the skin stiffened with calcareous spicula. The branchiæ of *Phyllidia*, arranged in plaits around the lower margin of the cloak, in the groove between it and the foot, show a relationship, in the character of these organs, to *Patella* and *Chiton*. The genus possesses neither jaws nor denticulated tongue. *Diphyllidia* has the tentacles

\* "Destitute of any covering, and presenting a marked peculiarity in their external branchiæ, their appearance is so very different, that every unprejudiced observer cannot but wonder they should, up to this day, have been mixed up with the true gasteropod shell-fish."—Swainston, 'Malacology,' page 36.

situated in advance of the frontal margin of the cloak; the anal opening is lateral, and the skin is destitute of spicula. But this genus makes a near approach to the Nudibranchs in the arrangement of the digestive apparatus, having a gastro-hepatic system, though the modification of the parts is somewhat peculiar. In taking an extended view of the order, these two genera ought perhaps to be included in it.\*

There is yet another order with which the Nudibranchs might be supposed to come into contact, through what, at first sight, appears to be an inosculating genus—the *Pulmonata*. Among the naked slugs, the marine genus *Onchidium* (*Peronia*, Blainv.) shows some approach to the *Nudibranchiate* tribes; but this is more apparent than real. In form it certainly very much resembles *Doris*, and, though the specialised breathing organ is a pulmonary cavity placed posteriorly beneath the cloak, yet there cannot be a doubt that, as in the Nudibranchs, the skin partakes largely in this function. This we infer, both from its structure and from the observed fact that the *Onchidium Celticum* has the power of remaining for a long period under water, without the necessity of coming to the surface to breathe. In some of the foreign species of this genus, the tubercles of the skin are prolonged, in the posterior part of the cloak, into branched processes, very similar to the gills of *Tritonia* and *Dendronotus*. This is remarkably the case in *Onchidium punctatum* (*Peronia Alderi*, Gray). There can be no doubt, however, that *Onchidium* is organised on the type of the *Pulmonata*, whether we look to the nervous, the digestive, or the reproductive system, as well as to that of respiration.

In their mode of development the Nudibranchs resemble very closely *Aplysia*, *Bulla*, and most of those genera of *Tectibranchiata* and *Inferobranchiata* in which the process has been observed. The spawn is likewise very similar. This is generally in the form of a gelatinous riband, assuming more or less of a spiral direction. The larvæ of *Aplysia* and *Bulla* are scarcely to be distinguished from those of *Tritonia* and *Doris*. These tribes differ from the *Pectenibranchiata* and the other orders in which the young come forth in a form resembling the mature animal, principally in the circumstance that the embryo issues from the egg in an earlier stage of development, and that the metamorphosis which it undergoes in all cases, takes place within the egg in the one instance, and after its extrusion from it in the other. The latter circumstance appears to imply a lower stage in the zoological scale, as it is found to be the rule in the lower classes of animals, though a very rare exception in the higher ones.

Besides the more obvious affinities here mentioned, M. de Quatrefages has endeavoured to show that a marked relationship exists between these Mollusks and most of the other classes of Invertebrate Animals; that, in fact, the "*Phlebenterata*," having, so to speak, thrown off many of the characters proper to the class to which they belong, have at the same time assumed others, typical of other great divisions of the animal kingdom. Thus, he traces in these Mollusks characters that ally them to the *Medusidæ*, the *Annelidæ*, the *Crustacea*, and even to the *Infusoria*. Believing as we do, that several of the characters given by M. de Quatrefages to his "*Phlebenterata*" are founded upon erroneous observations, we cannot of course agree in the conclusions drawn from them. If, for instance, as we believe, the idea that the branched appendages of the stomach perform the three functions of digestion,

\* Those authors who include the genera above mentioned amongst the *Nudibranchiata* do away with the order *Inferobranchiata*, and unite *Pleurobranchus* and the remaining genera of that order with the *Tectibranchiata* into an order, distinguished by having the gills on one side only, which they name *Pleurobranchiata*.



circulation, and respiration, be erroneous, the affinities of this tube with the Medusidæ must fall to the ground. In the *Planariæ*, too, the ramifications of the digestive system are apparently very different from those of the *Eolididæ*. M. de Quatrefages lays much stress upon the symmetrical and bilateral character possessed by the *Eolides*, which, he conceives, approach them very closely to the *Annelida*. We do not see much force in this observation. Most of the organs of the Mollusca possess normally a bilateral structure; and it is principally in those parts of the *Gasteropods* which are usually inclosed in a spiral shell that the arrangement is departed from. In proportion as the shell becomes a concave or flattened disc, or entirely disappears, the animal generally assumes a more symmetrical character. In few families, indeed, is this more observable than in some of the *Eolididæ*, and in this respect undoubtedly they may be considered to make a slight approach to the *Annelida*, as well as to the other tribes whose bilateral structure is more perfect; but this relationship cannot be looked upon as of much importance; nor can we perceive any real resemblance to the segment of annulose animals in the regular branching of the gastro-hepatic vessels. This system in the *Eolididæ*, to a certain extent, resembles the prolongations of the digestive organ in the Nymphons; but here also we see no reason for supposing that there is any true affinity between the two groups.

The intimate relationship of the *Nudibranchiata* with the other *Gasteropods* having been pointed out, it remains to inquire what rank they ought to hold in this Molluscan group. The great concentration of the ganglions in the nervous system would appear to indicate a higher place in the scale than is borne out by their other characters. The olfactory organs also reach their highest development in some of the genera of this order. But, on the other hand, the eyes, though formed on the usual type, being constantly buried under the skin, must be less effective instruments of sight than in those orders where they are raised on pedicels, and assisted by the modification and transparency of the epidermal layer. The simplification of the special breathing organs in some of the genera, taken in connexion with their entire disappearance in the nearly-allied *Pellibranchs*, and the great simplicity of form in the latter, undoubtedly imply a lower degree of organisation than in most of the *Gasteropods*, though by no means to the extent that has been assumed in those views, we have so often had occasion to combat in these pages. The hermaphroditism common to the whole of the order, and the peculiarities in their embryological development already pointed out, lead to the same conclusion. Upon the whole, therefore, it will be necessary to assign to the *Nudibranchiate* Mollusca a place amongst the lowest members of the class *Gasteropoda*.

ARRANGEMENT.—In reviewing the different arrangements of the *Nudibranchiata*, it will not be necessary to go further back than the ‘Regne Animal’ of Cuvier, with whom the order originated. In that work, the “*Nudibranches*” constitute the first order of the class *Gasteropoda* in a descending series. The genera, which are not divided into families, stand thus:—*Doris*, *Polycera*, *Tritonia*, *Thethys*, *Scyllæa*, *Glaucus*, *Eolidia*, and *Tergipes*. Very little alteration was made by Lamarck in his ‘*Animaux sans Vertèbres*.’ He included these animals in a single family,—“*Les Tritoniens*,”—reversing the order of the genera to suit his ascending arrangement, but still placing them first, consequently lowest, among the *Gasteropoda*, though in Cuvier’s system they formed the highest group. Ferussac, adopting the orders as well as the descending arrangement of Cuvier, divided the *Nudibranchs* into two sub-orders and three families, as follows:—

## 1st Sub-order. ANTHROBRANCHES.

1st Fam. '*Les Doris*.' Doris, Onchidoris, Polycera.

## 2d Sub-order. POLYBRANCHES.

2d Fam. '*Les Tritonies*.' Tritonia, Doto, Thetys, Scyllæa.3d Fam. '*Les Glauques*.' Laniogera, Glaucus, Eolis, Tergipes.

This is, in its essential points, the arrangement of the present day; very little alteration having been made beyond the addition of the genera since discovered. The arrangement of Blainville is that of Ferussac with an alteration of names. His orders "*Cyclobranchés*" and "*Polybranchés*" are the two sub-orders above mentioned; and his families "*Diceres*" and "*Tetracres*," in the latter order, correspond with the *Tritonies* and *Glauques* of Ferussac: these orders, however, were placed nearly the last in a descending series. Rang added two new families, *Les Pterosomes* and *Les Placobranches*: the former appears rather to belong to the *Nucleobranchiata*. We find in the British Museum Catalogue for 1840, the *Gymnobranchiata* (*Nudibranchiata*) comprises the following families:—1, *Doridæ*; 2, *Tritonidæ*; 3, *Placobranchidæ*; 4, *Phyllidiidæ*; 5, *Patellidæ*; 6, *Chitonidæ*. The two latter families have been withdrawn in Dr. Gray's subsequent arrangements, which we shall have to notice afterwards. M. D'Orbigny also includes the *Placobranchidæ* and *Diphyllidiadæ* in his order *Nudibranchiata* published in 1842.\*

The next arrangement we shall notice is that of M. de Quatrefages (1844). In conformity with his views on the anatomy of these animals, he detached the *Eolididæ* from the *Nudibranchiata*, leaving that order to consist of the *Dorididæ* and *Tritoniadæ* alone, and established a new order, *Phlebobranchiata*, in which he includes the *Eolididæ*, the *Placobranchidæ* of Rang, and a few small genera without special breathing organs, mostly new. His arrangement of the order PHELEBENTERATA is as follows:

Gasteropodous Mollusca with an imperfect circulation or none, and without respiratory organs properly so-called.

Fam. 1. Intestine ramified, and prolonged into the external appendages. ENTEROBRANCHES.

Tribe 1. Appendages isolated, more or less numerous. *Enterobranches proprement dit*.

Eolide, Eolidine, Zephyrine, Amphorine, Calliopée, Cavoline (?), Glaucus (?), &c.

Tribe 2. Appendages united in the form of oars. *Enterobranches remibranches*.

Actéon, Actéonie, Placobranchie (?), &c.

Fam. 2. Intestine very simple, in the form of a few pouches; no external appendages.

## DERMOBRANCHES.

Pavois, Chalide.

In the first part of the present work (1845) we arranged the British species then known in the following order:

Fam. 1. DORIDIDÆ. Branchial plumes surrounding the vent on the medio-dorsal line.

Sub-Fam. *Doridinæ*, with a cloak.

Doris, Goniadoris, Triopa.

Sub-Fam. *Polycerinae*, without distinct cloak.

Ægirus, Thecacera, Polycera, Idalia.

Fam. 2. TRITONIADÆ. Branchiæ, laminated, plumose or papillose, arranged down the sides of the back; stomach entire.

Tritonia.

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\* In his '*Paléontologie Française*.'

Fam. 3. *EOLIDIDÆ*. Branchiæ papillose or branched, arranged on the sides of the back ; stomach branched.

Sub-Fam. *Melibæinæ*. Tentacles 2, with sheaths.

*Dendronotus*, *Doto*.

Sub-Fam. *Eolidinæ*. Tentacles without sheaths, 2, 4, or none.

*Eolis*, *Pterochilus*, *Hermæa*, *Alderia*, *Proctonotus*.

Professor Allman, in his paper on the anatomy of *Actæon*,\* proposed a modified arrangement of the Nudibranchiate Mollusca, which we subjoin.

Order	Section.	Family.	Genera.
Nudibranchiata.	Liver compact	Branchiæ in the mesial line placed in a circle, more or less complete, round the anus.	Doris, Polycera, &c.
		<i>Dorididæ</i> .	
	Liver disintegrated	Branchiæ arranged along the sides or scattered.	Tritonia, Scyllæa, Thetis.
		<i>Tritoniadæ</i> .	
		Branchiæ papillose, or branched, or muricated.	Eolis, Alderia, Dendronotus, Glaucus, &c.
		<i>Eolididæ</i> .	
		Branchiæ foliaceous. <i>Actæonidæ</i> .	Actæon, Placobranchus ?

But the most extensive arrangement of the order yet published, is that of Dr. J. E. Gray, in Mrs. Gray's 'Figures of Molluscous Animals.' In this work the distribution of the whole of the known species into genera and families has been attempted. This, it must be acknowledged, is a very difficult task, with the present imperfect descriptions of foreign species ; and we do not think that, in all cases, Dr. Gray has succeeded in his details, but as that distinguished naturalist has superseded this arrangement by another in a late number of the 'Annals of Natural History,'† it is unnecessary to enter into any further description of it on the present occasion.

The classification now proposed by Dr. Gray, is founded upon the characters afforded by the spines of the tongue taken in conjunction with the breathing organs, and is as follows :

1. *Gills surrounding the vent on the middle of the hinder part of the back.*

Fam. 1. *ONCHIDORIDÆ*. Teeth 2 in each cross series ; gills in separate cavities ; mantle edging the foot and simple.

*Acanthodoris*, *Onchidoris*.

Fam. 2. *DORIDIDÆ*=*Doridina* and *Polycerina*, Gray. Teeth many in each cross series, sub-similar, inner often smaller ; gills in a common cavity ; mantle edge simple.

*a. Doris* ; *β. Goniodoris*, *Ceratosoma* ; *γ. Ægires*.

Fam. 3. *TRIOPIDÆ*=*Triopina*, Gray. Teeth many (rarely only 4) in each cross series, inner lateral ones large, irregular-shaped ; gills in a common cavity ; mantle small, edged with tentacles.

*Triopa*, *Idalia*.

\* Ann. Nat. Hist., v. 16, p. 145.

† Ib. 2d Ser., v. 11, p. 218.

2. *Gills superficial, generally in the form of fusiform processes, plaits, or branching vessels.*

*a. Tongue broad ; teeth many in each cross series.*

- Fam. 4. TRITONIADÆ. Tentacula sheathed ; gills fusiform or branched on each side of the back ; vent lateral ; jaws horny.

*Tritonia, Dendronotus, Scyllæa, Eumenis.*

- Fam. 5. PROCTONOTIDÆ. Tentacula simple, linear, not sheathed ; gills fusiform, on the sides of the back ; vent dorsal ; jaws horny, strong.

*Proctonotus, Antiopa.*

- Fam. 6. DIPHYLLIDIADÆ. Tentacula simple, united, expanded ? ; gills in folds on the under side of the edge of the mantle, which is bent up ; jaws horny.

*Diphyllidia.*

*b. Tongue narrow ; teeth in a single central series.*

- Fam. 7. DOTONIDÆ. Tentacula sheathed at the base, retractile ; gills fusiform, on the sides of the back.

*Doto.*

- Fam. 8. GLAUCIDÆ. Tentacula subulate, simple, rarely ringed, contractile ; gills fusiform or branched, on the sides of the back ; jaws often horny.

*a. Glaucus ; β. Eolidia, Montagua, Favorinus ; γ. Embletonia ; δ. Hermæa ; ε. Alderia.*

- Fam. 9. PLACOBANCHIDÆ. Tentacula subulate or linear, folded ; gills in the form of plaits or vessels radiating on the surface of the back.

*Placobranchus, Elysia.*

- Fam. 10. LIMAPONTIADÆ. Tentacula none or simple, contractile ; body depressed ; gills none external.

*Limapontia.*

- Fam. 11. PHYLLIRRHOIDÆ. Tentacula elongate-subulate ; body compressed vertically ; gills none external.

*Phyllirrhoë.*

*c. Tongue and jaws none.*

- Fam. 12. PHYLLIDIADÆ. Tentacula dorsal, anterior, retractile ; labial palpi close, conical, small ; gills in form of radiating folds on the under side within the edges of the mantle ; vent medial, posterior.

*Phyllidia, Fryeria.*

The character derived from the dentition of the tongue, it will be seen, has been largely used in the above arrangement. The value of the lingual apparatus in the classification of the Mollusca has lately occupied much attention, but has scarcely yet been satisfactorily determined. Taken as a primary character, this organ would lead to the most arbitrary grouping of dissimilar forms. As a secondary, it is more useful : but, still, subordinated as it has been by Dr. Gray to the disposition of the branchiæ, it appears to us to have been rather too much relied upon in his arrangement. Its indications are uncertain. In some groups the lingual spines will be found to vary very slightly throughout all the genera of a family ; while in others, different kinds of tongue are associated in genera which from their other characters evidently belong to the same family. This is frequently the case in the Nudibranchs as well as in the *Bullidæ* and some of their allies. Having paid great attention to the character

derived from the tongue in this order, we have come to the conclusion that it can scarcely be considered of more than generic importance; but, taken in connexion with other characters, especially with the presence or absence of jaws and prehensile collar, it will undoubtedly be found a valuable guide, and will often determine an alliance or a distinction where external indications fail; but like all other characters taken from a single organ, it is liable to lead to artificial grouping when carried too far.

The arrangement now adopted in this work is, as will be seen by the following Synopsis, an enlargement of that provisionally given in our first part, and restated in a previous page. Several genera and a large number of species have since been added, and some slight modifications have been made in the different groups. The plan of the work would not allow of any extensive alterations, and happily such were not required; though, could we have done so conveniently, we should have been inclined, with our present knowledge, to have raised our sections of *Doris* and *Eolis* to the rank of genera, as has been already done by Dr. Gray. The time has scarcely arrived when a complete general arrangement of the Nudibranchiate order can be undertaken with any degree of satisfaction. As a contribution to such an object, however, we have ventured to give the outline of a general arrangement on an enlarged basis, in our Appendix, a comparison of which with the systems of other authors here given, will serve to show how far our views coincide with theirs, and prevent the necessity of any extended critical remarks on the labours of our brother naturalists.

## ANALYTICAL TABLE OF THE FAMILIES AND GENERA.

(This Table is intended as an index to the Synopsis, and will, it is hoped, afford a ready means of ascertaining the genus of any specimen from an examination of the external characters.)

Branchiæ plumose, surrounding the vent on the medio-dorsal line . . . . .	Family .	DORIDIDÆ.
Cloak ample . . . . .	Sub-Fam. <i>Doridinæ</i> .	
Tentacles retractile within cavities . . . . .		Doris.
Cloak small or obsolete . . . . .	Sub-Fam. <i>Polycerinæ</i> .	
Tentacles retractile { Tentacles smooth . . . . .		Ægirus.
within sheaths { Tentacles laminated { Cloak distinct, with appendages .		Triopa.
		Cloak obsolete . . . . .
		Thecacera.
Tentacles non-retractile { Cloak distinct, with a smooth or undulated margin		Goniodoris.
without sheaths . . . . .		Cloak indistinct, with marginal filaments . . . . .
		Idalia.
		Cloak rudimentary, with marginal tubercles . . . . .
		Polycera.
		Cloak obsolete, tentacles with basal filaments . . . . .
		Ancula.
Branchiæ laminated or tufted, arranged along the sides of the back ; } liver entire . . . . .	Family .	TRITONIADÆ.
Branchiæ laminated, set along a pallial ridge at the sides of the back . . . . .		Tritonia.
Branchiæ tufted, covering the insides of lobes at the sides of the back . . . . .		Scyllæa.
Branchiæ papillose, rarely ramose, set along the sides of the back ; } liver defused and branched . . . . .	Family .	EOLIDIDÆ.
* Tentacles 2, sheathed ; branchiæ variable.		
Branchiæ ramose or papillose . . . . .	Sub-Fam. <i>Dendronotinæ</i> .	
Branchiæ ramose, without pallial ridge . . . . .		Dendronotus.
Branchiæ papillose, on a pallial ridge . . . . .		Lomanotus.
Branchiæ clavate and muricate . . . . .	Sub-Fam. <i>Melibæinæ</i> .	
Veil small . . . . .		Doto.
** Tentacles without sheaths ; branchiæ papillose.		
Vent lateral . . . . .	Sub-Fam. <i>Eolidinæ</i> .	
Tentacles 4 . . . . .		Eolis.
Tentacles 2 . . . . .		Embletonia.
Vent dorsal ; branchiæ not surrounding the head . . . . .	Sub-Fam. <i>Hermæinæ</i> .	
Tentacles 4, vent latero-dorsal . . . . .		Fiona.
Tentacles 2, vent medio-dorsal, anterior . . . . .		Hermæa.
Tentacles none, vent medio-dorsal, posterior . . . . .		Alderia.
Vent dorsal, posterior ; branchiæ surrounding the head . . . . .	Sub-Fam. <i>Proctonotinæ</i> .	
Dorsal tentacles united by a crest, laminated . . . . .		Antiopa.
Dorsal tentacles without crest, not laminated . . . . .		Proctonotus.

## SYNOPSIS.

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Sub-Kingdom—MOLLUSCA.

Class—Gasteropoda.

ORDER—NUDIBRANCHIATA.

Fam. 1. DORIDIDÆ. Branchiæ plumose, surrounding the vent on the medio-dorsal line. Skin spiculose.

Sub-Fam. DORIDINÆ. Cloak ample, with an entire margin.

GENUS 1. DORIS, LINNÆUS.

Cloak covering the head and foot. Dorsal tentacles 2, laminated, retractile within cavities. Oral tentacles 2, various, or wanting. *Fam. 1, Plates 1 and 2.*

*Section 1.* Branchiæ united at the base and retractile within a cavity; body more or less depressed; with oral tentacles. *Doris*, proper.

*Tongue broad, with numerous lateral spines and occasionally a central one.*

\* Oral tentacles tubercular.

*Lingual spines uniform: no central spine.*

*a. Lingual spines stout, plain.*

1. D. TUBERCULATA, *Cuv.* Orange or yellow, usually blotched with brown or olive; cloak covered with unequal flattish tubercles; dorsal tentacles conical; branchial plumes 9, tripinnate, large and spreading. Length 2 to 3 inches. *Pl. 3.*
2. D. FLAMMEA, *Ald. and Hanc.* Scarlet, occasionally blotched with purple; cloak covered with moderately sized, unequal, flattish tubercles; dorsal tentacles conical; branchial plumes 9, tripinnate, not spreading. Length 1 inch. *Pl. 4.*

*b. Lingual spines long, slender, denticulated.*

3. D. ZETLANDICA, A. and H. White; cloak with large, soft, conical, pointed, unequal tubercles; dorsal tentacles linear; branchial plumes 6, bipinnate. Length  $\frac{6}{10}$  inch. *Appendix* (1), p. i.

\*\* Oral tentacles linear.

*Lingual spines of two kinds, various: no central spine. Occasionally with a spinous buccal collar.*

4. D. MILLEGRANA, A. and H. Yellow or orange (?), cloak covered with minute, granular tubercles; branchial plumes 6, bipinnate. Length  $1\frac{1}{4}$  inch. *Appendix* (2), p. i.
5. D. JOHNSTONI, A. and H. Yellowish-white or yellow, with a few minute brown spots; cloak covered with minute, close-set, pilose tubercles; dorsal tentacles clavate; branchial plumes 15, tripinnate, forming a cup. Length  $1\frac{1}{2}$  to 2 inches. *Pl.* 5.
6. D. PLANATA, A. and H. Very flat, variegated brown and yellowish, with very unequal, soft, warty tubercles; dorsal tentacles subclavate; branchial plumes 7, small, tripinnate, mottled. Length 1 inch. *Pl.* 8.
7. D. COCCINEA, For. Scarlet, with a few minute black spots; cloak minutely tuberculated; dorsal tentacles broadly clavate; branchial plumes 10, small, simply pinnate, erect. Length  $\frac{1}{2}$  inch. *Pl.* 7.

\*\*\* Oral tentacles flattened.

*Lingual spines denticulated; a small central spine. A spinous buccal collar.*

8. D. REPANDA, A. and H. Waxy white; cloak with small, rather distant, soft tubercles; a row of sulphur-yellow or opaque white spots down each side; dorsal tentacles subclavate; branchial plumes 5, tripinnate, small. Length 1 inch. *Pl.* 6, and *Appendix* (3), p. ii.

*Section 2. Branchiæ simply pinnate, set separately in an open circle, non-retractile; without oral tentacles, their place being supplied by a veil. Lamellidoris.*

*Tongue narrow; lingual spines few.*

- \* Body not greatly depressed; cloak with moderate-sized spicula; spawn of few coils, cupformed.

*Tongue with 2 large spines and 2 or more rudimentary ones: \* usually a quadrangular central plate.*

9. D. ASPERA, A. and H. White; cloak with stout, flattish, clavate tubercles; tentacles sub-conical; branchial plumes 11, small, erect. Length  $\frac{9}{10}$  inch. *Pl.* 9, *figs.* 1—9.
10. D. PROXIMA, A. and H. Orange yellow; cloak with stout elliptical tubercles; tentacles sub-clavate; branchial plumes 11. Length  $\frac{1}{2}$  inch. *Pl.* 9, *figs.* 10—16.
11. D. MURICATA, Müll. Yellowish-white; roundish, cloak with large, close-set, rounded, clavate tubercles; branchial plumes 8—10 (Lov). Length  $\frac{9}{10}$  inch. *Appendix* (4), p. ii.
12. D. ULIDIANA, Thomp. Pale-yellow, oblong; cloak with rather large, unequal, depressed tubercles; tentacles slender, linear; branchial plumes 11, beautifully white, set in a semicircle. Length  $\frac{1}{2}$  inch. *Appendix*, (5) p. ii.
13. D. DIAPHANA, A. and H. Very transparent, white; cloak with equal, clavate, rather distant tubercles; tentacles nearly linear, stout; branchial plumes 11, yellowish, set in an open, incomplete circle; liver appearing through the skin very large and black. Length  $\frac{1}{2}$  inch. *Pl.* 10.

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\* To avoid repetition it may be stated here that the number of spines given in the descriptions of the tongues has reference to a single transverse row only. The rows of spines are numerous.



14. *D. OBLONGA*, *A.* and *H.* Yellowish with brown spots, oblong, tapering behind; cloak with conical spiculose tubercles; tentacles subclavate; branchial plumes 7, rather close, surrounded by a circle of large tubercles. Length  $\frac{1}{2}$  inch. *Pl.* 16, *figs.* 4, 5.

15. *D. BILAMELLATA*, *Linn.* Dull white, mottled and blotched with brown in a longitudinal direction, cloak covered with large, unequal, clavate tubercles; tentacles linear; branchial plumes 20—29, small, disposed in a horse-shoe form, with the ends curved inwards; Length  $\frac{1}{2}$  to  $1\frac{1}{4}$  inch. *Pl.* 11.

\*\* Body very flat, with large spicula, symmetrically arranged; spawn of many narrow coils.

*Tongue with 2 large broad spines and 2 rudimentary ones; no central plate.*

16. *D. DEPRESSA*, *A.* and *H.* Pale sandy-coloured, spotted with reddish-brown; very much depressed; cloak with linear pointed papillæ, transparent, shewing the spicula conspicuously; tentacles linear; branchial plumes 11, small, set in an open circle. Length  $\frac{3}{10}$  inch. *Pl.* 12, *figs.* 1—8.

17. *D. INCONSPICUA*, *A.* and *H.* Purplish-white, with minute brown spots, not very much depressed; cloak with small obtuse tubercles; tentacles subclavate, stout; branchial plumes 10, white, set in an open circle. Length  $\frac{1}{2}$  inch. *Pl.* 12, *figs.* 9—16.

18. *D. FUSILLA*, *A.* and *H.* Fulvous, thickly covered with dark brown spots, ovate, depressed; cloak with numerous conical tubercles; tentacles slender, conical, white; branchial plumes 9, pure white, obtuse, set in a rather open circle. Length  $\frac{3}{10}$  inch. *Plate* 13, and *Appendix* (6), p. iii.

19. *D. SPARSA*, *A.* and *H.* Yellowish-white, with distant fulvous spots or blotches, depressed; cloak with distant, roundish, rather flat tubercles; tentacles sub-conical, white blotched with brown, with three or four tubercles surrounding the base of each; branchial plumes 9, set in a rather open circle. Length  $\frac{1}{4}$  inch. *Pl.* 14.

*Section 3.* Branchiæ united at the base, non-retractile; body convex; oral tentacles indistinct, united into a veil. *Acanthodoris*, Gray.

*Tongue narrow, with 2 large denticulated spines and 6 or 8 rudimentary ones: no central spine.*

*A spinous buccal collar, with an under rudimentary jaw.*

20. *D. PILOSA*, *Müll.* White, yellow, brown, or blackish, very convex, subpellucid; cloak with slender, pointed papillæ; tentacles long, slightly bent, with small denticulated sheaths; branchial plumes 7 to 9, large and spreading, forming a star in the centre. Length  $\frac{1}{2}$  to  $1\frac{1}{4}$  inch. *Pl.* 15.

21. *D. SUBQUADRATA*, *A.* and *H.* White, subpellucid, rather elevated; cloak small, subquadrangular, scarcely covering the head and foot, set with small conical papillæ; tentacles subclavate, with smooth sheaths; branchial plumes 7, large, spreading transversely; foot large and thick. Length 1 inch. *Pl.* 16, *figs.* 1, 2, 3; and *Appendix* (7), p. iii.

Sub-Fam. POLYGERINÆ. Cloak small or obsolete, generally with marginal appendages.

## GENUS 2. GONIODORIS, FORBES.

Cloak small, exposing the head, with a waved or scalloped margin, without appendages. Dorsal tentacles 2, laminated, non-retractile. Oral tentacles flattened and angular. Branchial plumes non-retractile. *Fam.* 1, *Pl.* 17.

*Tongue narrow, with 4 plates; the 2 next the median line bearing each a large spine: no central plate. A spinous buccal collar.*

1. *G. NODOSA*, Mont. White tinged with yellow and pink, with opaque white spots; cloak with a scalloped margin, and a central ridge with 1 or 2 rows of tubercles on each side; branchial plumes 13, simply pinnate. Length 1 inch. Pl. 18.
2. *G. CASTANEA*, A. and H. Reddish-brown spotted with white; sides much tuberculated; cloak very small, with a reflected margin and a central ridge; branchial plumes 7—9, tripinnate. Length  $\frac{3}{4}$  to 1 inch. Pl. 19.

### GENUS 3. TRIOPA, JOHNSTON.

Cloak small, covering the head, with linear or subclavate marginal appendages. Dorsal tentacles 2, laminated, retractile within small sheaths. Oral tentacles 2, cylindrical. Branchial plumes non-retractile.

*Tongue rather broad, with numerous plates, the two innermost on each side bearing large spines: no central plate.*

1. *T. CLAVIGER*, Müll. White; cloak with orange tubercles and the marginal appendages tipped with yellow; branchial plumes 3, bipinnate. Length  $\frac{3}{4}$  inch. Pl. 20.

### GENUS 4. ÆGIRUS, LOVÉN.

Body convex, covered with large tubercles. Cloak indistinct, forming a veil over the head and a tuberculated ridge on each side. Dorsal tentacles 2, linear, smooth, retractile within sheaths. Branchial plumes non-retractile.

*Tongue broad, with numerous, simple, curved, lateral spines: no central plate. An upper corneous jaw.*

1. *Æ. PUNCTILUCENS*, D'Orb. Purple-brown, with darker areas, each containing a central, brilliant, greenish-blue spot; branchial plumes 3, tripinnate, whitish. Length  $\frac{3}{4}$  inch. Pl. 21, and Appendix (8), p. iii.

### GENUS 5. THECACERA, FLEMING.

Body smooth; cloak obsolete; veil indistinct, variable. Tentacles 2, laminated, retractile within sheaths. Branchial plumes non-retractile, with lateral appendages.

*Tongue with 14 or 16 plates, the 2 inner plates on each side bearing bicuspid spines: no central plate. Small lateral corneous jaws.*

1. *T. PENNIGERA*, Mont. White spotted with orange and black; veil bilobed; tentacular sheaths bilobed; branchial plumes 5; branchial appendages one on each side, large, bifid. Length  $\frac{1}{2}$  inch. Appendix (9), p. iii.
2. *T. VIRESCENS*, A. and H. Peach-blossom coloured with green blotches before and behind; tentacles green, with small, plain sheaths; branchial plumes 5, greenish, edged with white; branchial appendages, several, tubercular, obsolete. Length  $\frac{9}{10}$  inch. Appendix (10), p. iv.
3. *T. CAPITATA*, A and H. White freckled with greenish-brown; tentacles with small plain sheaths; veil with 2 to 4 orange tubercles on each side, and a row of orange tubercles between the tentacles; branchial plumes 7, pinnate, tipped with orange; a stout branchial lobe on each side, also tipped with orange. Length  $\frac{1}{4}$  inch. Appendix (11), p. iv.

## GENUS 6. POLYCERA, CUVIER.

Body smooth or tuberculated. Cloak indistinct, forming a digitated veil, and a ridge bearing a row of tubercles on each side of the back. Tentacles 2, laminated, non-retractile, without sheaths. Branchial plumes non-retractile, with lateral appendages.

*Tongue rather narrow, with 12 to 16 plates, the 2 next the centre on each side large, bicuspid: no central plate. Lateral corneous jaws.*

*Section 1.* Veil dilated into tentacular filaments; branchial appendages linear, 1 on each side.

1. *P. QUADRILINEATA*, Müll. White, with lines of yellow tubercles, and sometimes spotted or striped with black and orange; veil large, digitated; branchial plumes 7 to 9, pinnate; processes all tipped with yellow. Length  $\frac{1}{2}$  to  $\frac{3}{4}$  inch. Pl. 22.

*Section 2.* Veil short, bilobed and tuberculated; branchial appendages tubercular, more than one on each side.

2. *P. OCELLATA*, A. and H. Greenish-black, with large, tubercular, yellowish-white spots; veil tuberculated, whitish, continued along the sides to the branchial appendages, which are lobated and branched; branchial plumes 5, bipinnate; tentacles conical. Length  $\frac{1}{2}$  inch. Pl. 23.
3. *P. LESSONII*, D'Orb. Green or yellowish, with yellow tubercles; veil short, with numerous yellow tubercles continued along the sides to the branchial appendages, which are much lobated and yellow; branchial plumes 3, bipinnate; tentacles clavate. Length  $\frac{1}{2}$  inch. Pl. 24.

## GENUS 7. ANCULA, LOVÉN.

Body smooth; cloak obsolete, represented by a row of filaments on each side of the branchiæ. Tentacles 2, clavate, laminated, non-retractile, with styliform basal appendages. Head produced at the sides into tentacular processes.

*Tongue narrow, with 4 spines, the 2 next the median line large and broad, with the inner margin denticulated: no central spine. A spinous buccal collar.*

1. *A. CRISTATA*, Ald. White, with the processes tipped with yellow or orange; tentacular appendages 2 at the base of each tentacle; branchial plumes 3, tripinnate; branchial appendages 5 on each side. Length  $\frac{1}{2}$  inch. Pl. 25.

## GENUS 8. IDALIA, LEUCKART.

Body smooth, convex; with a small indistinct cloak, margined with filaments, longest in front of the tentacles. Head much produced in front, plain, thick. Tentacles 2, linear, laminated, non-retractile, without sheaths. Branchiæ simply pinnate, non-retractile. Foot large.

*Tongue narrow, with 4 spines, the 2 next the median line large: no central spine. A spinous buccal collar.*

*Section 1.* Centre of the back with filaments.

*Lingual spines next the centre large, falcate, and smooth or minutely denticulated; lateral spines short. Spinous collar complete.*

1. I. ELEGANS, *Leuck.* Rose-coloured, freckled, the processes orange-yellow; anterior filaments 2; lateral filaments numerous, irregular, the posterior ones obtuse, lobular; dorsal filaments 5,—3 on the median line, and 2 sub-lateral; branchial plumes 18 (the anterior and posterior ones bifid); foot margined with yellow. Length  $1\frac{1}{2}$  inch. *Pl.* 27, *figs.* 1—4.
2. I. LEACHII, *A. and H.* White; filaments very long; anterior 4, lateral 6 on each side, the posterior ones bifid; dorsal filaments numerous, in 3 or 5 rows; branchial plumes 11 (the anterior one bifid). Length 1 inch. *Pl.* 27, *fig.* 5.

*Section 2. Centre of the back without filaments.*

*Lingual spines next the centre large, recurved and strongly denticulated; lateral spines much hooked. Spinous collar incomplete, bilobed.*

3. I. ASPERSA, *A. and H.* Reddish or yellowish, freckled with orange and reddish-brown; anterior filaments 4 (2 close to the base of each tentacle) of equal length, long; lateral filaments short, 2 or 3 on each side near the branchiæ; branchial plumes 10 (the anterior and posterior ones bifid), short, equal, forming a circle. Length  $\frac{1}{2}$  inch. *Pl.* 26, and *Appendix* (12), p. iv.
4. I. INÆQUALIS, *For.* Gray, speckled with yellow and brown; anterior filaments 4 (2 near the base of each tentacle), unequal, the exterior ones longest; lateral filaments short, 5 or 6 on each side; branchial plumes 9 (the anterior one bifid), slender, diminishing posteriorly. Length 1 inch. *Appendix* (13), p. v.
5. I. PULCHELLA, *A. and H.* Freckled with pale lilac; tentacles sub-clavate; anterior filaments 4, set on an expanded pallial ridge; lateral filaments 5 or 6 on each side, the last large and bifid; branchial plumes 11 (the anterior one bifid), rather small, diminishing posteriorly. Length  $\frac{4}{10}$  inch. *Appendix* (14), p. v.
6. I. QUADRICORNIS, *Mont.* Mottled brown and white; anterior filaments 2 (1 near the base of each tentacle), long; lateral filaments small, obscure; branchial plumes 8 or 9. Length  $\frac{3}{8}$  inch. *Appendix* (15), p. v.

Fam. 2. TRITONIADÆ. Branchiæ plumose or tufted, set along the sides of the back. Liver entire, central. Skin without spicula.

### GENUS 9. TRITONIA, CUVIER.

Body sub-quadrilateral. Branchiæ plumose or laminated, set on a pallial ridge along the sides of the back. Tentacles 2, fasciculated, with plain sheaths. Veil digitated. Anus lateral. *Fam.* 2, *Pl.* 1.

*Tongue broad, with very numerous, simple or denticulated lateral spines: a tricuspid central spine, and a plate on each side of it. Large corneous jaws.*

1. T. HOMBERGII, *Cuv.* Purplish-brown or flesh-coloured, strongly tuberculated; veil bilobed, with numerous small digitations; branchiæ plumose, sub-foliateous, forming a nearly continuous line on each side. Length 3 to 6 inches. *Pl.* 2.
2. T. ALBA, *A. and H.* Transparent white with opaque white transverse markings, rather depressed, smooth, or very faintly tuberculated; branchiæ imperfectly bipinnate, 4 or 5 on each side, with intermediate smaller ones, set on an expanded and waved pallial margin; veil bilobed with irregular digitations. Length  $\frac{3}{4}$  inch. *Appendix* (16), p. vi.

3. *T. PLEBEIA*, *Johns*. Marbled with brown and yellowish above, subquadrate; veil entire, with 8 points; branchiæ small, bipinnate, 5 or 6 on each side. Length 1 inch. *Pl.* 3.
4. *T. LINEATA*, *A. and H.* Transparent white, very slender, with a line of opaque white down each side of the back; veil with 4 linear processes; branchiæ small, pinnate, 5 on each side. Length  $\frac{5}{8}$  inch. *Pl.* 4.

GENUS 9 *bis*. SCYLLÆA, LINNÆUS.

Body compressed, with large lobes on each side of the back, bearing the branchiæ in small tufts on their inner surface. Tentacles 2, laminated, with large sheaths. *Fam.* 2, *Pl.* 5.  
*Tongue broad, with numerous lateral spines and a central spine, all denticulated. Corneous jaws.*

1. *S. PELAGICA*, *Linn.* Cream-coloured, transparent, with 2 large branchial lobes on each side of the back, and a posterior dorsal crest; tentacular sheaths trumpet-shaped, frilled posteriorly. Length  $1\frac{1}{2}$  inch. *Appendix* (17), p. vi.

*Fam.* 3. *EOLIDIDÆ*. Branchiæ papillose or fusiform, rarely ramose, set along the sides of the back. Liver diffused. Skin without spicula.

Sub-Fam. *DENDRONOTINÆ*. Tentacles 2, laminated, retractile within sheaths. Branchiæ branched or papillose. Veil with processes. Anus lateral.

## GENUS 10. LOMANOTUS, VERANY.

Body subquadrilateral. Branchiæ papillose or foliaceous, arranged in a nearly continuous line on a pallial ridge on the sides of the back. Tentacles 2, with tight sheaths. (*Eumenis*, *A. and H.*, included in *Pl.* 5 of *Fam.* 2.) *Appendix* (18), p. vii.

*Tongue broad, with numerous denticulated spines: no central spine. Corneous jaws.*

1. *L. marmoratus*, *A. and H.* Olivaceous, marbled with brown and white; tentacles with smooth sheaths; branchiæ forming a nearly continuous waved line of papillæ on each side of the back. Length  $\frac{1}{2}$  inch. *Fam.* 3, *Pl.* 1a (*Eumenis marmorata*).
2. *L. flavidus*, *A. and H.* Pale lemon-yellow; tentacles with tuberculated sheaths; branchiæ papillose, mostly short, with a few longer ones at regular intervals, all ringed with fawn-colour. Length  $\frac{1}{4}$  inch. *Pl.* 41, *figs.* 6, 7.

## GENUS 11. DENDRONOTUS, ALDER and HANCOCK.

Body compressed, without cloak. Branchiæ ramose, set in single series on each side of the back. Tentacles with branched sheaths. Veil branched. *Fam.* 3, *Pl.* 2.

*Tongue rather narrow, with numerous lateral spines, and a large central spine, all denticulated. Corneous jaws.*

1. *D. ARBORESCENS*, *Müll.* Reddish, marbled with brown; veil much branched; branchiæ 6 or 7 on each side. Length 1 to 2 inches. *Pl.* 3.

Sub-Fam. MELIBINÆ. Tentacles 2, plain, retractile within sheaths. Branchiæ clavate. Anus latero-dorsal.

#### GENUS 12. DOTO, OKEN.

Body without cloak. Branchiæ ovate, muricated, set in single series on each side. Tentacles filiform, with short trumpet-shaped sheaths. Veil short and smooth. *Fam. 3, Pl. 4.*

*Tongue very narrow, consisting of a single plate with a large central spine and minute lateral denticles. No jaws.*

1. D. FRAGILIS, *For.* Uniform yellowish-brown or olive; branchiæ robust, ovate-conical, without terminal spots, 7 to 9 on each side. Length 1 inch. *Pl. 5.*
2. D. PINNATIFIDA, *Mont.* Yellowish or olive, spotted with brown and black; veil arched; branchiæ ovate-conical, 7 to 9 on each side, the tubercles slender, each with a terminal black spot. Length  $\frac{4}{10}$  inch. *Pl. 45.*
3. D. CORONATA, *Müll.* Yellowish-white spotted with red; branchiæ ovate or subclavate, 5 or 6 on each side, with a terminal purple spot on each tubercle. Length  $\frac{1}{2}$  inch. *Pl. 6.*

Sub-Fam. EOLIDINÆ. Without cloak. Tentacles 4 or 2, non-retractile, without sheaths. Branchiæ simple, papillose. Anus lateral. Gastro-hepatic system with a posterior central vessel.

#### GENUS 13. EOLIS, CUVIER.

Tentacles 4, linear. Branchiæ set in transverse rows along the sides of the back. *Fam. 3, Pls. 7 and 8.*

*Tongue narrow, generally of a single plate. Corneous jaws.*

*Section 1.* Branchiæ numerous, subcompressed and crowded; angles of the foot sharp.

Spawn of several undulating coils. *Eolis* proper.

*Lingual plate broad, uniformly pectinated.*

*\*Lingual plate a single arch.*

1. E. PAPILLOSA, *Linn.* Brown, gray, or orange, spotted with brown and white, ovate, subdepressed; branchiæ stout, set in 18—24 transverse rows; head broad, usually with a triangular mark; tentacles short; anterior angles of the foot rather short. Length  $1\frac{1}{4}$  to 3 inches. *Pl. 9.*

*\*\* Lingual plate a double arch.*

2. E. GLAUCA, *A. and H.* Brick-red, subdepressed; branchiæ conical, vermicular, glaucous or olivaceous, spotted with brown and white, set in 14 rows; tentacles smooth; anterior angles of the foot a little produced. Length  $1\frac{3}{4}$  inch. *Pl. 11, and Appendix (19), p. vii.*
3. E. ALDERI, *Cocks.* Grayish-white; branchiæ subconical, set in 12 to 14 rows, the first 2 or 3 white, the rest gray marbled with brown, with yellow apices; tentacles yellowish; anterior angles of the foot a little produced. Length  $\frac{7}{10}$  inch. *Pl. 10, figs. 5, 6.*

*Section 2.* Branchiæ clustered: angles of the foot produced. *Flabellina.*

*\* Tentacles laminated. Spawn of many undulated coils.*

*Lingual plate with a strong central spine and marginal denticles.*

4. *E. CORONATA*, *For.* Whitish, slender; branchiæ linear, oblong, crimson reflecting blue and tipped with white, set in 6 or 7 clusters; dorsal tentacles strongly annulated, with 7 or 8 rings; oral tentacles long; anterior angles of the foot a little produced. Length 1 inch. *Pl.* 12, and *Appendix* (20), p. vii.
5. *E. DRUMMONDI*, *Thomp.* Whitish, stout; branchiæ long, sublinear, reddish or brownish with white tips, set in 4 to 6 clusters; dorsal tentacles densely annulated, with 20 to 30 rings; oral tentacles very long; anterior angles of the foot much elongated. Length  $1\frac{1}{4}$  inch. *Pl.* 13, and *Appendix* (21), p. viii.
6. *E. PUNCTATA*, *A. and H.* Yellowish flesh-coloured, covered with white spots; branchiæ oblong, acute, yellowish-brown, set in 5 or 6 clusters; dorsal tentacles obliquely laminated; oral tentacles long; angles of the foot much produced. Length 1 inch. *Pl.* 15.
7. *E. ELEGANS*, *A. and H.* Yellowish-white; branchiæ rosy flesh-coloured, margined above and below with blackish-purple, apices white, set in 7 clusters; dorsal tentacles stoutish, corrugated; oral tentacles long; anterior angles of the foot produced. Length  $\frac{1}{2}$  inch. *Pl.* 17, *figs.* 2, 3, 4.

\*\* Tentacles smooth. Spawn of many undulating coils. *Coryphella*, Gray.

*Lingual plate as in the last, with 2 separate, lateral, denticulated spines.*

8. *E. RUFIBRANCHIALIS*, *Johns.* White, very slender; branchiæ linear, rose-coloured with white tips; set in 6 or 7 clusters; tentacles of moderate length, the oral pair shortest; angles of the foot short. Length 1 inch. *Pl.* 13.
9. *E. LINEATA*, *Lov.* White, pellucid, slender, with 3 longitudinal opaque white lines on the body; branchiæ linear, rose-coloured, with a white line in front and white tips, set in 4 or 5 clusters; tentacles with a white line on each, the oral pair longest; anterior angles of the foot produced. Length 1 inch. *Pl.* 16.
10. *E. SMARAGDINA*, *A. and H.* White, slender; head short; branchiæ elliptic-oblong, green with white tips, set in 5 clusters; tentacles long, of equal length; anterior angles of the foot produced. Length  $\frac{1}{2}$  inch. *Pl.* 17, *fig.* 1.
11. *E. GRACILIS*, *A. and H.* White, slender; head longish; branchiæ elliptical, orange with white tips, set in 4 or 5 clusters; tentacles long; anterior angles of the foot much produced. Length  $\frac{1}{2}$  inch. *Pl.* 18.
12. *E. PELLUCIDA*, *A. and H.* White, slender, pellucid; branchiæ linear, scarlet with white tips, set in 5 or 6 clusters; tentacles long, of equal length; anterior angles of the foot much produced. Length  $\frac{7}{8}$  inch. *Pl.* 19.
13. *E. LANDSBURGII*, *A. and H.* Violet-coloured, slender; branchiæ elliptic-linear, orange-red with white tips, set in 5 or 6 clusters; tentacles violet-coloured, with white tips, the oral pair longest; anterior angles of the foot rather short. Length  $\frac{1}{2}$  inch. *Pl.* 20, and *Appendix* (22), p. viii.

\*\*\* Tentacles with a bulbous swelling (or smooth?). Spawn of many plain coils. *Favorinus*, Gray.

*Lingual plate with a single smooth spine.*

14. *E. ALBA*, *A. and H.* White, slender; branchiæ linear-oblong, rather depressed, white, sometimes spotted or ringed with brown, with white tips, set in 5 or 6 clusters; dorsal tentacles blackish-brown, white above, with a bulbous swelling; oral tentacles very long; anterior angles of the foot much dilated. Length  $\frac{3}{4}$  inch. *Pl.* 21, and *Appendix* (23), p. viii.

15. E. CARNEA, *A.* and *H.* Flesh-coloured, slender; branchiæ linear-conical, rose-coloured, set in 7 clusters; tentacles rather long, of equal length, the dorsal pair dark olive-brown, paler above, oral pair whitish; anterior angles of the foot much produced. Length  $\frac{1}{2}$  inch. *Appendix* (24), p. ix.

\*\*\*\* Tentacles plain, small; branchiæ on footstalks.

*Lingual plate with a small smooth (?) spine.*

16. E. GLAUCOIDES, *A.* and *H.* White, depressed; head small; tentacles small, smooth; branchiæ linear, white, with yellowish tips, and a narrow, pale fulvous, central gland, set in 11 pedunculated clusters; foot broad, with the anterior angles acute, short. Length  $\frac{1}{2}$  inch. *Pl.* 22, *figs.* 1—4.

*Section 3.* Branchiæ in transverse, generally rather distant, rows. Angles of the foot short.\*  
*Cavolina*, Cuvier.

\* Branchiæ in close transverse rows; sides of the head produced; angles of the foot rounded. Spawn a depressed semicircular mass.

*Lingual plate with a large central spine and marginal denticles.*

17. E. PEACHII, *A.* and *H.* Yellowish or flesh-coloured, subdepressed; branchiæ numerous, subclavate, yellowish-brown tipped with white, set in 20 rows; dorsal tentacles rather long; oral tentacles shorter. Length  $\frac{3}{4}$  inch. *Pl.* 10, *figs.* 1—4.
18. E. NANA, *A.* and *H.* Yellowish-white, ovate-oblong; branchiæ subclavate, rose-coloured, set in 8 to 10 rows; tentacles of moderate length. Length  $\frac{4}{10}$  inch. *Pl.* 25.

\*\* Branchiæ in rather close rows; angles of the foot variable.

*Lingual plate denticulated, with the central spine not prominent.*

19. E. STIPATA, *A.* and *H.* Yellowish-green, ovate, subdepressed; branchiæ elliptical or subclavate, green, set in 9 or 10 rows, nearly covering the back; angles of the foot short. Length  $\frac{1}{4}$  inch. *Pl.* 22, *fig.* 5.
20. E. ANGULATA, *A.* and *H.* Pale orange, subangulated, depressed; branchiæ cylindrical, orange spotted with white, set in 10 or 12 rows; dorsal tentacles short; oral tentacles rather longer; anterior angles of the foot much produced, pointed. Length  $\frac{4}{10}$  inch. *Pl.* 23.
21. E. INORNATA, *A.* and *H.* Pale fulvous, ovate, subdepressed; branchiæ elliptic-cylindrical, fawn-coloured or reddish, spotted with brown and white, set in 9 rows; tentacles short; anterior angles of the foot a little produced, pointed. Length  $\frac{4}{10}$  inch. *Appendix* (25), p. ix.
22. E. CONCINNA, *A.* and *H.* Whitish; branchiæ purple-brown, with a metallic lustre, tipped with white, set in 9 or 10 rows; tentacles smooth, the dorsal pair longest; anterior angles of the foot short. Length  $\frac{1}{4}$  inch. *Pl.* 24.
23. E. OLIVACEA, *A.* and *H.* Yellowish-white, with opaque white spots; a pink streak on each side of the head; branchiæ cylindrical, olivaceous, obscurely banded, set in 6 or 8 rows; dorsal

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\* We have adhered to the four sections given in our description of the genus, but the information acquired since the period of its publication makes it necessary to subdivide them a little more. The 3d section is composed of rather heterogeneous materials, some of which scarcely agree with its general character. This is more especially the case with the first division.



tentacles with a rose-coloured band; anterior angles of the foot rounded. Length  $\frac{1}{2}$  inch.

*Pl. 26, and Appendix (26), p. x.*

24. E. AURANTIACA, A. and H. Buff-coloured, rather robust; branchiæ purple-orange below, with a white ring above and bright orange tips, set in 10 or 11 rows; dorsal tentacles rosy orange, of moderate length; oral tentacles shorter; anterior angles of the foot rounded. *Pl. 27.*
25. E. PUSTULATA, A. and H. White, pellucid; branchiæ long, linear, obtuse, yellowish-orange, granulated with white, set in 9 or 10 rows; tentacles shortish; anterior angles of the foot rounded. Length  $\frac{1}{4}$  inch. *Pl. 46, figs. 4, 5.*

\*\*\* Branchiæ in rather distant rows; anterior angles of the foot rounded.

*Lingual plate denticulated, with the central spine a little prominent.*

26. E. COUCHII, Cocks. Bluish-black, with opaque white spots, anterior parts and tail white; branchiæ ovate-oblong, transparent white with opaque white spots, set in 4 distant rows of 3 papillæ each; tentacles white, linear, the dorsal pair longest. Length  $1\frac{3}{4}$  inch. *Appendix (27), p. x.*
27. E. AMENA, A. and H. Greenish-white, with brown markings and white spots; branchiæ yellowish-green with yellow spots, set in 8 distant rows; tentacles with a brown band, the oral about half the length of the dorsal pair. Length  $\frac{3}{10}$  inch. *Pl. 30, and Appendix (28), p. x.*
28. E. NORTHUMBRICA, A. and H. Greenish-white; branchiæ subclavate, dark bluish-green, set in 9 remote rows; dorsal tentacles obtuse, annularly corrugated, oral pair rather shorter; anterior angles of the foot a little produced. Length  $\frac{1}{4}$  inch. *Pl. 31, figs. 2, 3.*
29. E. ARENICOLA, For. White, slender; branchiæ linear, blackish-green, with yellow tips, set in 15 rows; tentacles long, pointed, yellowish. Length  $\frac{3}{4}$  inch. *Pl. 31, fig. 1.*
30. E. GLOTTENSIS, A. and H. Greenish-yellow; branchiæ robust, blackish-green, with golden-orange tips, set in 8 or 9 rows; tentacles rather long, obtuse. Length  $\frac{4}{10}$  inch. *Pl. 29, figs. 5—8.*
31. E. VIRIDIS, For. Greenish-white, slender; branchiæ linear, pointed, bright green, strongly tipped with white, set in 10 rather distant rows; tentacles of equal length, longish; anterior angles of the foot slightly produced. Length  $\frac{3}{10}$  inch. *Pl. 32.*
32. E. PURPURASCENS, Flem. Pink, slender; branchiæ filiform or subclavate, set in 5 rows of 3 each; dorsal tentacles moderately long; oral tentacles very short. Length 1 inch. *Appendix (29), p. xi.*

\*\*\*\* Branchiæ inflated; anterior angles of the foot rounded. Spawn cup-formed.

*Lingual plate with large denticles and a stout central spine. Two separate plain lateral spines.*

33. E. CINGULATA, A. and H. White, spotted and blotched with olive-brown; branchiæ elliptic-oblong, white with 3 rings of olive, set in 8 or 9 distant rows; tentacles with a fulvous band. Length  $\frac{4}{10}$  inch. *Pl. 28.*
34. E. VITTATA, A. and H. Yellowish with ferruginous markings; branchiæ subclavate, pale buff or flesh-coloured, with 3 brown bands and yellowish tips, set in 6 or 7 distant rows. Length  $\frac{3}{10}$  inch. *Pl. 29, figs. 1—4.*
35. E. CÆRULEA, Mont. Green, nearly linear; branchiæ ovate, green at the base, blue in the middle, and orange at the apex, set in 6 rather distant rows; tentacles linear, green. Length  $\frac{1}{4}$  inch. *Appendix (30), p. xi.*
36. E. PICTA, A. and H. White, spotted with orange-brown and opaque white; branchiæ ovate, inflated, spotted with brown, set in 7 or 8 rows; tentacles with a fulvous band. Length  $\frac{1}{4}$  inch. *Pl. 33.*

37. *E. TRICOLOR*, *For.* Buffish-yellow, ovate-oblong; branchiæ elliptical, inflated, with a violet central vessel and yellow tips, set in 13 or 14 rows. Length 1 to  $1\frac{1}{4}$  inch. *Pl.* 34.
38. *E. AMETHYSTINA*, *A. and H.* Yellowish-white; branchiæ elliptical, much inflated one way and depressed the other, with the central vessel purple, granulated, and a broad ring of pale orange-red at the top, set in 10 rows; dorsal tentacles twice the length of the oral ones. Length  $\frac{3}{8}$  inch. *Appendix* (31), p. xi.
39. *E. FARRANI*, *A. and H.* Yellowish-white or lilac, with orange spots; branchiæ ovate-oblong, inflated, yellowish-white or lilac, with a ring of bright orange near the apex, set in 9 or 10 rows; tentacles banded with orange. Length  $\frac{1}{2}$  inch. *Pl.* 35, and *Appendix* (32), p. xii.
40. *E. EXIGUA*, *A. and H.* Yellowish-white marbled with brown; branchiæ ovate, abruptly pointed, with 2 or 3 bands of brown, reddish above, set in 5 rows of 1 or 2 each; dorsal tentacles longish, oral rather short, both banded with brown. Length  $\frac{9}{10}$  inch. *Pl.* 37, and *Appendix* (33), p. xii.

*Section 4.* Branchiæ fusiform, set in a single row on each side of the back; sides of the foot rounded. Spawn reniform. *Tergipes*, Cuvier.

*Lingual plate with a stout central spine and marginal denticles.*

41. *E. DESPECTA*, *Johns.* White, with an undulating olivaceous line in the middle of the back; branchiæ ovate, white with a yellowish or olivaceous granulated centre, and generally a reddish ring near the top; dorsal tentacles long, smooth; oral tentacles short. Length  $\frac{9}{10}$  inch. *Pl.* 36, and *Appendix* (34), p. xii.

#### GENUS 14. EMBLETONIA, ALDER and HANCOCK.

Tentacles 2, linear, dorsal; the oral pair fused into two flattened lateral lobes. Branchiæ few, fusiform, set generally in single series down the sides of the back.

*Tongue, a single plate bearing a central spine and lateral denticles. Corneous jaws.*

1. *E. PULCHRA*, *A. and H.* Flesh-coloured, spotted with white; tentacles short, distant; branchiæ elliptical, orange-red spotted with white, 5 or 6 in single series on each side. Length  $\frac{9}{10}$  inch. *Pl.* 38.
2. *E. MINUTA*, *For. and Goods.* Pinkish-yellow, linear; tentacles longer than in the last, wrinkled; branchiæ linear, vermicular, pinkish, tipped with white, arranged in single file, 7 on each side. Length  $\frac{1}{8}$  inch. *Appendix* (35), p. xii.
3. *E. PALLIDA*, *A. and H.* Yellowish-white with a few black spots on the back; tentacles approximating; head-lobes indistinct, forming a semicircular veil, produced at the sides; branchiæ nearly linear, very pale orange, set in 4 or 5 rows of 2 papillæ each on each side. Length  $\frac{1}{10}$  inch. *Appendix* (36), p. xii.

Sub-Fam. HERMEINÆ. Tentacles 4, 2, or none. Anus dorsal. Digestive system with 2 lateral posterior gastro-hepatic vessels.

#### GENUS 15. FIONA, ALDER and HANCOCK.

Branchiæ numerous, papillose or fusiform, with a membranous expansion down the side of each; set on the sides of the back. Tentacles 4. Anus latero-dorsal. *Fam.* 3, *Pl.* 38a.

*Tongue, a single stout plate with a central spine and marginal denticles. Corneous jaws.*

1. *F. NOBILIS*, *A.* and *H.* Buff or whitish; tentacles long, tapering, both pairs similar; branchiæ crowded, with the central vessel dark brown, and an opaque iridescent apex. Length 2 inches. *Pl.* 38a, *fig.* 1.

GENUS 16. *HERMÆA*, LOVÉN.

Without cloak. Branchiæ papillose, set on the sides of the back. Tentacles 2, ear-shaped. Anus antero-dorsal. *Appendix* (37), p. xii.

*Tongue*, a single plate bearing a broad spine. *No jaws.*

*Section 1.* Tentacles with both margins terminating at the sides of the head; body cylindrical.

1. *H. BIFIDA*, *Mont.* Yellowish-white, with 2 red lines along the back, slender; tentacles rather short, truncated, rising in a point behind; branchiæ oblong, slightly tuberculated, with a ramified rose-coloured vessel in the centre of each. Length 1 inch. *Pl.* 39.

*Section 2.* Tentacles with the anterior margin continuous with the side of the head, forming a sub-veil; body with the sides depressed and slightly expanded.

1. *H. DENDRITICA*, *A.* and *H.* Greenish-white with dendritic green veinings; tentacles oblong ear-shaped; branchiæ elliptic-linear, green, spotted with white. Length  $\frac{3}{10}$  inch. *Pl.* 40.

GENUS 17. *ALDERIA*, ALLMAN.

Without cloak. Head with two lateral lobes or rudimentary tentacles. Branchiæ papillose, set in transverse rows on the sides of the back. Anus postero-dorsal.

*Tongue* a single plate with a large central spine. *No jaws.*

1. *A. MODESTA*, *Lovén.* Yellowish, variegated with brownish-gray; branchiæ elliptical, set in 6 or 8 rows, increasing in size posteriorly; foot large, reflected at the sides. Length  $\frac{1}{2}$  inch. *Pl.* 41.

Sub-Fam. PROCTONOTINÆ. Tentacles 4, non-retractile, without sheaths, oral pair small. Branchiæ papillose. Anus postero-dorsal. Posterior vessel of the gastro-hepatic system central.

GENUS 18. *PROCTONOTUS*, ALDER and HANCOCK.

Branchiæ arranged on an obsolete pallial ridge, on the sides of the back and in front of the head. Dorsal tentacles simple, linear. Oral tentacles originating in a veil.

*Tongue* broad, with numerous spines. *Corneous jaws.*

1. *P. MUCRONIFERUS*, *A.* and *H.* Fawn-coloured, marbled with brown; branchiæ inflated, hyaline, mucronated, set in 12 rows on a pallial ridge on the sides of the back, with 4 large ones in front. Length  $\frac{1}{2}$  inch. *Pl.* 42.

## GENUS 19. ANTIOPA, ALDER and HANCOCK.

Branchiæ arranged on a pallial ridge on the sides of the back and in front of the head. Dorsal tentacles laminated, united by a semicircular crest. Oral tentacles with or without a veil. *Fam. 3, Pl. 43.*

*Tongue broad, with numerous lateral spines and a central one, all simple. Corneous jaws.*

1. A. CRISTATA, *Della Chiaje*. Transparent buff-coloured or white; branchiæ ovate-oblong, inflated, with a slender brown central vessel furcated above, the apices of a brilliant opaline blue; dorsal tentacles strongly laminated. Length  $1\frac{1}{4}$  inch. *Pl. 44, figs. 1—7.*
2. A. HYALINA, *A. and H.* Pellucid, yellowish with brown markings down the middle of the back; branchiæ elliptical, tuberculated, hyaline, with the central vessel fulvous; dorsal tentacles obtuse, obscurely laminated; oral tentacles united by a narrow veil. Length  $\frac{3}{10}$  inch. *Pl. 44, figs. 8—12.*

## Fam. 1, Plates 1 and 2.

### GENUS 1. DORIS,\* LINNÆUS.

*Corpus* ellipticum, depressum, rarius convexum, pallio plerumque tuberculato obtectum; pallium ultra caput et pedem extensum. *Caput* inferius, tentaculis 2 labialibus, nonnunquam obsoletis, vel in velum conjunctis. *Tentacula dorsalia* 2, subclavata et laminata, intra foramina retractilia. *Branchiæ* plumosæ, anum circumdantes, posticè in lineâ mediâ dorsi positæ. Apertura genitalis ad latus dextrum.

When Linnæus first proposed the genus *Doris*, in the tenth edition of the 'Systema Naturæ,' he so far misunderstood its characters as to describe the vent for the mouth, which he conceived to be surrounded by a circle of tentacles. This mistake, pardonable in that early stage of science, he corrected in the twelfth edition of his celebrated work, and the genus, as there described, and for the first time properly established, is pretty nearly the same as it is now understood by zoologists of the present day. Gmelin, however, so much enlarged the limits of the genus *Doris* as to make it nearly co-extensive with the whole order of the Nudibranchiate Mollusca, and his example was followed by most of the naturalists of the Linnæan School. In the more accurate classification of Cuvier, *Doris* was again reduced within the limits of the Linnæan characters, though from the imperfect knowledge of these animals still at that time prevailing, many species were at first included in it, which were afterwards detached to form new genera, as these characters became better understood. It is not necessary to enumerate the genera that were thus formed, as most of them will be found described in the family of the *Dorididæ*. Even as at present restricted, the genus still contains a large number of species, and that number is daily being increased by the discoveries of modern travellers, as well as by the more careful investigation of native species by European zoologists. As yet the different groups are scarcely sufficiently understood to allow of a satisfactory division of the whole genus; but at some not very distant period, such a division will certainly be required, and distinctive characters are not wanting on which several new genera might be established. Before noticing some of the attempts that have been made towards the accomplishment of this object, it will be necessary to give a more detailed view of the characters of the genus as it at present stands.

The body of *Doris* is elliptical, and generally more or less depressed, but in some species convex. It is covered on all sides by a cloak, which extends beyond the head and foot; the cloak is generally tuberculated or granulated, seldom quite smooth, and is more or less stiffened with calcareous spicula, imbedded in its substance. The head is indistinct, placed

\* *Doris*, a sea-nymph, daughter of Oceanus and Thetys.

## DORIS.

between the cloak and the foot in front, and is furnished with two oral tentacles, very variable in shape, sometimes linear, sometimes tubercular or flattened, and sometimes their place is supplied by a veil, which surrounds the head, and may be considered a modification of these organs. The mouth is occasionally slightly protuberant; it is most commonly without jaws, but sometimes very rudimentary ones exist; and it is frequently furnished with a spinous prehensile collar at the buccal orifice. The tongue is denticulated. *Doris* was long supposed to be without eyes. Those organs, however, are always present; but in most cases must perform the function of vision very imperfectly, as they are seldom to be seen through the skin excepting in some very transparent species, or in very young individuals. There are two dorsal tentacles, which are placed on the cloak in front, and at some little distance from the margin; their form is generally linear or clavate, the upper portion being always laminated; they are retractile within cavities, the margins of which are sometimes produced into short sheaths. The branchiæ are plumose and surround the anus, which is situated posteriorly on the central line of the back. They consist of several plumes, sometimes small and simple, sometimes large, and more or less branched; and are either united at the base into a flower-like expansion, or placed separately in a circle, more or less broken posteriorly. In the typical division of the genus, these plumes are retractile within a common cavity, the margin of which is capable of being closed completely over them, so as to protect them from danger. In those abnormal species that form our second and third sections there is no cavity; the plumes are consequently not retractile, but contractile only, being, in their contracted state, curled up, and drawn closely down on the surface of the cloak. The foot is flat disc of an oblong form. The aperture of the sexual organs is single, and situated anteriorly on the right side between the cloak and the foot.

We are inclined to believe that the Dorides are carnivorous; but this fact has not been sufficiently investigated. *D. tuberculata* has been detected feeding on *Halichondria panicea*, and *Grantia compressa*, and the stomach of this species is almost always found filled with fragments of the former sponge. It is likewise worthy of remark, that *D. depressa*, *D. sparsa*, and *D. inconspicua* are found adhering to calcareous zoophytes, on which there can be little doubt that they feed.

This genus has a wide geographical range, species occurring from the frozen to the torrid zones, and in every quarter of the globe. In depth it extends from the littoral to the coralline zone; but is most abundant in the littoral and laminarian. Some species are found equally abundant in both these zones; and in particular *D. pilosa* may be mentioned. This species has a peculiar structure within the stem of the branchial leaflet highly developed, giving the characteristic star-like appearance in the centre of the branchial circle. The structure just alluded to is also found in *D. tuberculata*. It is composed of a series of irregular cells with thickish elastic walls, and is apparently intended to give reciliency to the branchial plumes, keeping them to some extent expanded, even when out of water, and thus, perhaps, certain species may be enabled to extend their range to within tidal marks.

Ehrenberg made an attempt at a redivision of this genus in his 'Symbolæ Physicæ,' published in 1831; his arrangement, however, does not include the whole of the forms contained in the genus, but appears to be confined to the species that had come under his observation. He restricts the genus to those species (not otherwise distinguished) which have the branchiæ retractile within a cavity, and divides them into the following sub-genera.

## DORIS.

- a.* Branchiis simpliciter ligulatis. GLOSSIDORIS.
- b.* Branchiis ligulatis, apicibus furcatis, incisive. ACTINODORIS.
- c.* Branchiis simpliciter radiatis, radiis simpliciter pinnatis. PTERODORIS.
- d.* Branchiis radiatis, ramosis, compositis, fruticulosus. DENDRODORIS.

He also describes four new genera founded upon foreign species, some of them rare, and still remaining unfigured. His sub-genera, it will be observed, are formed from the character and mode of branching of the branchial plumes. We do not think that these will be found to lead, in all cases, to natural groups: to divide the simply pinnate from those with doubly pinnate or branched plumes, would occasionally separate species very closely allied; for instance, no two species are more closely allied than our *Doris Johnstoni* and *Doris coccinea*; yet, according to Ehrenberg's views, the former would be a *Dendrodoris* and the latter a *Pterodoris*.

In our provisional synopsis to the present work, published in 1845, we divided the British species of *Doris* into three sections, characterised by the position of the branchiæ, and their retractibility into a cavity or otherwise. These divisions, which we still adhere to, are given below.

But the most extensive subdivision of the Dorides is that of Mr. J. E. Gray, in the fourth volume of Mrs. Gray's 'Figures of Molluscous Animals,' published in 1850. In this, Ehrenberg's sub-genera are adopted and raised to the rank of genera, with the exception of *Pterodoris*, which is left out, and *Dendrodoris* is divided into two, *Dendrodoris* and *Doris*; the former being restricted to species with the anus behind the branchiæ, a distinction which we think will not hold good, as the species therein enumerated have the anus really in the centre to which the plumes converge, though the circle is incomplete. Our second section, which Mr. Gray adopts as a genus, he considers to be the *Onchidoris* of Blainville; the character on which that naturalist separates his genus from *Doris* is not, however, to be found in the animals composing this section. Our third section Mr. Gray forms into a genus under the name of *Acanthodoris*. He also adopts the genus *Villiersia* of D'Orbigny, which we have ventured to discard for reasons mentioned in our account of *Doris depressa*. Some other genera proposed by Mr. Gray, having reference to foreign species only, we shall not at present stop to consider, more especially as the descriptions of authors are in general so imperfect, that without some more accurate information concerning structural peculiarities (independently of colour and markings, which are frequently the only characters given) it would be impossible to come to any very satisfactory conclusions with regard to the great mass of species now included in the genus. For this reason, we shall content ourselves with giving the following groups as sections only, though there can be little doubt that they will ultimately rank as genera.

Section 1. Branchiæ united at the base, and retractile within a cavity; body more or less depressed; with oral tentacles. Type, *Doris tuberculata*.

Section 2. Branchiæ set separately in an open circle, non-retractile; without oral tentacles, their place being supplied by a veil. Type, *Doris bilamellata*.

\* Body not much depressed, with moderately sized spicula; spawn generally of few coils, and cup-formed. Type, *D. bilamellata*.

\*\* Body very flat, with large spicula, symmetrically arranged; spawn narrow, of many coils. Type, *D. depressa*.

Section 3. Branchiæ united at the base, non-retractile; body convex; oral tentacles indistinct, united into a veil. Type, *Doris pilosa*.

## DORIS.

The species in the first section show varieties of structure that might admit of farther subdivision, but the British forms contained in it are so few, that we think it unnecessary at present to carry the analysis further.

Cuvier has given a description and figures of the anatomy of *Doris* in the 'Memoires des Mollusques;' but these, though sufficient for the purpose then contemplated by the great physiologist, do not go much into detail. It seems desirable, therefore, to extend our observations in the present work; and for that purpose we have, with the assistance of our friend Dr. Embleton, made careful dissections of the various groups of the genus, and shall now give the results of our investigations at some length, as in this instance they relate to the typical member of a family.

The mouth opens in front between the cloak and foot, and conducts by a short constricted channel (Pl. 1, fig. 6 *e*), which is provided with an outer (*c*) and an inner lip (*d*), to the buccal mass. This is a highly developed organ, of an irregular oval form, the walls (*g*) being composed of numerous strong muscles, some to assist in the motions of the tongue, others to aid in carrying the whole apparatus to and from the oral aperture.

The buccal organ varies to some extent in our three sections; in the first (Pl. 2, fig. 1 *a*) it is simple and well developed; in the second (Pl. 1, fig. 13 *b*) it is small, and has in addition a large, circular, and beautifully organised muscular gizzard (*c*) attached to its upper surface, into which this gizzard opens a little in front of the œsophagus. The gizzard is very peculiar, and we believe nothing like it has been hitherto noticed. It is somewhat lentiform, with the walls very thick and firm, smooth in the interior, having the sides externally covered with regular radiating muscular fibres, and a strong muscular belt encircling the margin. This modification is observed in *D. bilamellata*, *D. aspera*, and *D. depressa*. In the third section the buccal apparatus (fig. 12 *b*) is very large, being apparently an incorporation or blending of the ordinary buccal mass, and the gizzard (*c*) of section 2. It is anteriorly enlarged and rounded, with the channel (*a*) of the mouth opening into it on the under surface, and not in front, as in the other two sections (fig. 13 *a*).

The tongue (fig. 6 *i*) consists of a tubular dentigerous membrane, the upper portion of which is partly enclosed within, and partly expanded upon a conical muscular mass (*h*), (the lingual muscles), the base of which occupies the floor of the mouth, the apex pointing forwards, and the expanded dentigerous surface being opposed to the œsophagus. The lower part of the tongue is prolonged into a delicate pouch (fig. 3 *m*), which projects beyond the posterior and under part of the buccal organ. In this pouch is generated the membrane, which in its turn gives origin to numerous recurved teeth or spines in rows, which, as they are formed, are, together with the membrane, gradually pushed onwards; and as those before them are worn away or broken, they successively ascend, and eventually reach the upper expanded part of the tube, which is spread out upon the upper surface of the conical mass of lingual muscles. It is this upper part of the tube (figs. 4 and 7 *a*), expanded like the mouth of a trumpet, that alone performs the office of prehension; the other, more strictly tubular portion (*b*), of considerable length in some species, is that in which the teeth are developed, perfected, and retained until brought into connexion with the muscular apparatus.

In the first section the tongue is broad (fig. 7), and the rows of teeth transverse. In *D. tuberculata* the rows are forty four in number, each row comprising one hundred and forty



## DORIS.

simple teeth (figs. 8, 9). There is no central tooth in this species, any more than in *D. Johnstoni* or *D. coccinea*, in both of which the teeth are likewise simple; but in the former of these the outer teeth suddenly become excessively attenuated, and in the latter attenuated and elongated. *D. Johnstoni* has twenty-four rows, each of about fifty teeth. The tongue of *D. repanda* is provided with a central tooth (fig. 10 *a*) bearing four recurved denticles, and has the lateral teeth (figs. 10, 11) with regularly serrated sides. This species has sixty-eight rows, of thirty-seven teeth each. In our second section, represented by *D. bilamellata* and *D. aspera*; and in our third section, typified by *D. pilosa*, the tongue (Fig. 3 *l*, and Fig. 4) is narrow and strap-shaped, being composed of only two rows of teeth, and these placed longitudinally. In these species, therefore, this organ, having a wedge-shaped muscular support (fig. 3 *k*), has a general resemblance to that of *Eolis*. It is nevertheless essentially formed as in other Dorides, and has the posterior portion tubular (fig. 4 *b*). The two rows are of lateral teeth, the central ones being entirely deficient. There are twenty-eight teeth (fig. 5), in each row in *D. pilosa*, with the sides minutely denticulated. The teeth are equally numerous in *D. bilamellata*, but the sides are plain.

Besides the tongue, some of the Dorides are provided with a spinous prehensile collar (fig. 3 *h*), situated at the entrance of the buccal apparatus, and placed in a vertical position on what may be termed the buccal lip (*g*). This collar is of nearly uniform breadth in *D. repanda*, and is densely covered with minute, curved, bifid spines. In *D. pilosa* it is provided with similar spines (Pl. 2, figs. 3, 4, 5), and is divided into two lateral portions (fig. 2 *b*, *b*), broad below, and tapering to five points above. These two portions of the collar have, intervening between them below, two minute triangular processes (*c*) of a horny plate (fig. 6), which is buried in the buccal lip, having only the free points exposed; these are inclined upwards and forwards. This plate with its processes may, perhaps, be looked upon as the homologue of the jaws in *Eolis*; though this relation may admit of doubt, nevertheless it appears to be accessory to the prehensile action of the collar. The prehensile collar and jaws of *D. subquadrata* closely resemble those of *D. pilosa*. *D. bilamellata* is provided with a similar horny plate and processes, but much less developed, and the collar is very indistinct, having the surface only roughened with dense, minute wrinkles. *D. coccinea* is also furnished with a spinous prehensile collar. These five are the only species in which we have detected this curious organ, which is probably a compensation for the deficiency of well-developed jaws.

A pair of salivary glands (fig. 1 *h*), generally in form of long slender tubes, open into the mouth, one on each side of the œsophagus; *D. bilamellata* has these tubes replaced by a follicular mass (Pl. 1, fig. 13 *e*) attached to the posterior part of the buccal apparatus; and in *D. pilosa* they (fig. 12 *d*) are enlarged and folliculated at their bases.

The œsophagus (Pl. 2, fig. 1 *b*) in *D. tuberculata* is a nearly straight tube passing from the posterior dorsal aspect of the buccal organ; it is slightly enlarged after passing through the nervous collar, and is then continued on, of equal diameter, to the posterior or cardiac end of the stomach, which (Pl. 1, fig. 2 *b*, and Pl. 2, fig. 1 *c*) is a very large pyriform pouch, having the inner surface minutely corrugated. It lies on the left side of the body, and has the narrow posterior end resting between the lobes of the liver. Here the biliary fluid is poured in by a large canal (Pl. 2, fig. 1 *g*), and at this part, too, a small pancreatic organ (*i*) gives its secretion to the stomach by the side of the œsophagus. The intestine (*d*, *d*) leaves the

## DORIS.

stomach at the anterior end, and curving upwards, passes obliquely backwards, towards the right side, and to the nipple-formed anus (*e*) amidst the branchial plumes.

The alimentary canal of *D. pilosa* differs considerably from the above. In this species the œsophagus, at its origin, is dilated, forming a large membranous sac or crop (Pl. 1, fig. 12*f*), and is again enlarged (*g*) before it reaches the liver (*h*): it then passes into that viscus, and shortly afterwards receives the biliary secretion by three or four enormous openings (*i*). The canal, now somewhat increased in diameter, and assuming the characters of a stomach (fig. 1 *b*, and fig. 12*j*), emerges from the liver at its upper surface, and turning suddenly backwards, passes in the form of intestine (fig. 1 *c*) along the right side of the back to the anus, situated as usual. The stomach is internally minutely plicated, and has a small pancreatic sac (*d*) attached to its pyloric extremity.

The form of the alimentary canal in *D. pilosa* would appear to predominate in the genus. In *D. Johnstoni* the type is the same, only the crop at the commencement of the œsophagus is wanting. So it is with *D. bilamellata*, the crop being likewise deficient, unless the gizzard opening into the buccal organ be considered as its homologue; a view which we do not consider probable. In this species, too, the enlargement of the œsophagus (fig. 13*f*), previous to its entering the liver, has the walls of a glandular character. *D. repanda*, *D. coccinea*, *D. aspera*, and *D. depressa* have all the alimentary canal constructed after the same plan. In most, the inner surface of the stomach, and in all, the intestines, are longitudinally plicated.

The liver is large (Pl. 1, fig. 1 *e*, and fig. 2 *d*, *d*), filling the posterior part of the body; it is pyriform, the broad end, which is usually bilobed, being in front. The ducts from its different portions converge towards one or more short, very wide trunks in the interior. These open so immediately and largely into the stomach, that the alimentary matters cannot fail of passing freely into them, as is the case in *Eolis*.

The organs of the reproductive system (Pl. 1, fig. 2 *e*, *f*, *g*, *h*) are remarkable for their large size, high development, and complicated arrangement, being of the usual hermaphrodite character of the order. The intromittent organ (Pl. 2, fig. 7 *b*) is of considerable size, and, in its contracted state, lies in front immediately within the common orifice. The testis (*c*) is a long, simple, convoluted tube, with the extremities connected, one with the penis at its base, and the other with the oviduct at the sudden turn which that tube makes before entering into the channel of the mucus-gland, not far from the vulva, an arrangement identical with that of *Eolis*. The ovarium (*d*) is spread over the liver, leaving generally a portion of the under surface uncovered. The oviduct (*e*, *e*), passing from the anterior border of the liver-mass, becomes suddenly dilated (*f*), and passes sinuously to the front of the mucus-gland, and then turns abruptly backwards. Here (*g*) it receives the testis, as before stated, and immediately afterwards sinks into the mucus-gland, and being joined by the duct (*h*) from the androgynous apparatus, debouches into the female channel.

The mucus-gland is a large, irregularly rounded, compressed mass, composed of two parts; one (*h*, *h*) semi-pellucid and colourless, the other (*i*) opaque and reddish, the latter being imbedded in the former; both these parts are made up of the folds of a convoluted tube, which in the opaque portion is very minute. This portion receives the oviduct, and both parts of the glands communicate with a common channel (*j*), which is very short, and leads to the external ovarian orifice.

## DORIS.

There are two spermathecae and two channels; one of these latter leads from the exterior to the spermathecae, the other from them to the oviduct. The orifice of the vagina or external channel lies above and between the male and ovarian outlets. The vagina (*n*) is large, longitudinally plicated internally, and opens freely into the principal spermatheca (*k*). This is a large, globular sac of a purple-brown colour, lying between the male and female parts. Just where the vagina opens into it, the channel (*l*) leading to the oviduct leaves it. This channel is soon joined by the minute duct from the accessory spermatheca (*m*), and then unites with the oviduct, where it sinks into the mucus-gland.

The reproductive organs are thus arranged in *D. tuberculata*; and, notwithstanding numerous modifications in the various species, the connexions of the parts are the same in all. In *D. bilamellata*, *D. pilosa*, *D. repanda*, and *D. aspera*, the testis diminishes in length, and increases in thickness. In *D. repanda* it has appended to it a constricted duct-like tube, that keeps up its connexion with the intromittent organ. In *D. Johnstoni* and *D. coccinea* the testis (fig. 8 *c*) is composed of a large, glandular, fusiform mass, bent upon itself, and made up of a minutely convoluted tube. One end of this mass is connected to the intromittent organ (*a*) by a short duct (*b*), and the other communicates with the oviduct (*f*) at the usual place of its union with the testis.

In addition to this interesting modification of the testis, *D. Johnstoni* is furnished with a solid stiletto, contained within a sac (fig. 8 *o*, and fig. 10 *a*, *b*) placed in front of the penis; this stiletto (figs. 9, 10, 11) is capable of being protruded through an orifice (fig. 9 *f*) proper to itself, situated at the extremity of a long penis-like organ (*d*), and the bottom of the sac receives one end of a slender duct, which comes from a large glandular body (fig. 8 *g*). The stiletto is probably an instrument of excitement, like the dart of the common snail. Spermatozoa (fig. 12) are found in vast abundance in the spermathecae, and in the dilated portion of the oviduct. In the principal spermatheca they are mostly in a state of development, contained in large fusiform spermatophora; in the accessory spermatheca, they are always mature and arranged in parallel order, but in the dilated portion of the oviduct they are confusedly crowded together. The head of the spermatozoa is slightly enlarged, fusiform, and bent considerably to one side; the tail being very delicate, long, linear, and generally undulated.

The heart lies upon the upper surface of the posterior part of the liver-mass, immediately below the skin, and just in front of the branchial circle. It consists of an auricle (Pl. 1, fig. 2 *k*) and a ventricle (*j*) enclosed within a membranous pericardium (*i*). In addition to these parts, there is another propelling organ (*n*) lying under the pericardium, and opening into it. The great systemic artery (Pl. 2, fig. 1 *o*) comes from the front or apex of the pyriform muscular ventricle, and gives off branches to the various organs. The blood so distributed, with the exception of that sent to the liver-mass (*f*), becomes extravasated among the tissues, and thus finds its way into the general visceral cavity, and thence by orifices in its walls into the regular network of sinuses or spongy tissue of the skin. It then passes into a great lateral trunk-sinus running backwards on each side of the body, and reaches the lateral angles of the auricle by distinct systemic veins (Pl. 1, fig. 2 *l*, *l*). This portion of the blood never reaches the gills; it is only that which goes to supply the liver-mass that passes through the specialised breathing organ. The blood supplied to this mass, which comprises liver, ovary, and renal organ, passes into minute venous branches, which converge and unite into a

## DORIS.

common hepatic trunk-vein, lodged in a median depression on the upper surface of the mass. This trunk opens into an internal or venous branchial circle, closely surrounding the anus. The blood thence traverses the branchial leaflets, and falls into a second or external circular canal at the base of the branchial crown; from the anterior limb of this outer circle, a short wide trunk (*m*), the true brancho-cardiac vein opens forward on the median line into the posterior border of the auricle of the heart. Here the blood from the liver-mass, having been fully aerated in the special respiratory organ, becomes mixed up with that from the other viscera, which has been partially aerated on its return through the skin to the heart; the whole surface of the cloak of *Doris* being covered with vibratile cilia, as well as the branchiæ. The surface of the crawling disc is likewise covered with these minute organs.

The additional propelling organ, situated, as before mentioned, underneath the pericardium, is the organ which Cuvier calls "a vesicle acting as reservoir to a canal, which, coming backwards from the liver, opens at the external orifice placed close to the anus." This vesicle or heart (fig. 13 *o*) is pyriform, and has the interior plicated in a manner to prevent the return of fluid that has once passed through the orifice (*q*), which is also capable of being contracted like the mouth of a purse. The base or broad end opens into the pericardium, the narrow end tapers to a tube (*r*), which, after perforating the wall of the large sinus, to be presently described, turns suddenly forwards along the median fissure of the liver, and, branching, goes to inosculate with a minute network formed by twigs of the hepatic arteries. Venous blood from the general visceral cavity, finds its way by minute orifices in the floor of the pericardium into the interior of that cavity, and is thence drawn into the Cuvierian vesicle or heart, and then propelled by it along its tubes and branches, which are arterial in disposition, into the network just described. This apparatus, then, has a decidedly portal character. The blood traversing this network is conveyed through the liver into the hepatic trunk-vein.

It is evident from the above description, that the systemic circulation is divided into two portions; one general, the other partial; the latter being combined with a portal circulation. It is only from this hepatic course, in which the blood is more completely deteriorated, that it is sent to the branchiæ.

The small orifice (Pl. 2, fig. 1 *r*, and Pl. 1, fig. 13 *l*) near the anus has no communication, as Cuvier thought it had, with this vesicle or portal heart, but leads at once into an extensive more or less ramified cavity or sinus (Pl. 1, fig. 13 *k*, *k*'), the trunk of which extends forwards along the median fissure of the liver. This cavity is circumscribed by a delicate membrane, which is found beneath the pericardium; it has the aorta (*n*') running along its roof, and the great hepatic vein along its floor, which is intimately adherent to, and undistinguishable from, the capsule of the liver-mass.

In the wall of the cavity lies the network from the two sources already named; the inner surface of the whole of this membrane is covered with a fine spongy-looking, glandular tissue, which is most abundant over the tracts of the vessels. It is pretty evident that this is an apparatus for the elaboration of some fluid from the blood, and as the sinus opens externally by a small orifice close to the anus, it may be inferred that it is for excretion, and is probably a renal organ.

The fine network of veins in the walls of the renal cavity varies in different species. It is most developed in *D. bilamellata* (fig. 13), from which the above description is chiefly taken:

## DORIS.

in *D. repanda* and *D. pilosa* (fig. 1 *p, p*), it is also very extensive; but in *D. tuberculata* (Pl. 2, fig. 1 *q, q*) the arrangement of these vessels is probably much simpler, little more than the main trunks being visible. The cavity, too, in this species is more branched than usual.

The nervous system of *Doris* comprises two portions:—a cephalic or cerebral, and a sympathetic or organic. The cephalic, in *D. tuberculata*, is of an orange colour, and is made up of two series of ganglia, supra- and infra-œsophageal, with their commissures and numerous nerves. The supra-œsophageal ganglia are five pairs, and a single ganglion; the pairs being symmetrically placed with regard to the median line. Three pairs predominate in size. The anterior or sensorial (Pl. 2, fig. 13 *a, a*), the cerebroid of M. Blanchard, lie next the median line, across which they are connected; they are pyriform, with the broad end forward. Springing from about the middle of the anterior border, and from the upper surface of these, is a pair of ganglia (*d, d*), corresponding to the pedunculated pair of *Eolis*,—the olfactory. In *Doris* they are nearly sessile; and though in size much inferior to the cerebroid, are nevertheless of notable dimensions. They give off each a large nerve to supply the dorsal tentacles, which constitute the first pair. The next three pairs come off from the under surface of the anterior border of the cerebroid ganglia, external to the attachment of the first pair; the second and fourth run forward and supply the muscles and skin at the side of the channel of the mouth and the lips. The third passes to the oral tentacles. The fifth pair comes off close to the fourth, and soon divides into two branches; one goes on to the under part of the channel of the mouth and lip, the other courses round under the buccal mass, and unites with the corresponding nerve of the opposite side to form the anterior collar (*g*), which is slender and wide. External and close to the fifth pair, comes off on each side a nervous trunk, which, curving under the œsophagus, joins the principal infra-œsophageal ganglia. This trunk constitutes the second collar (*h*). The nerves of the sixth pair are generally very short, and come off from two minute elliptical ganglia, almost sessile, upon the external border of the cerebroid ganglia; these are the optic nerves and ganglia. The seventh pair of nerves appear to have no trunks, for the auditory capsules are sessile upon the same ganglia immediately behind the eyes.

The posterior or branchial ganglia (*b, b*) are, when distinct, broadly ovate, and connected with both the cerebroid and pedial ganglia. The eighth, ninth, and tenth pairs of nerves belong to the branchial ganglia, and are distributed to the whole of the mantle; the tenth sending a branch of communication to the branchial ganglia of the sympathetic system.

The lateral or pedial ganglia (*c, c*) lie on a plane beneath the others, with both of which they are connected; and are generally in shape and size like the branchial. Three large nerves, the eleventh, twelfth, and thirteenth pairs, pass off from these centres, and are for the supply of the whole foot. Two small ones, the fourteenth and fifteenth pairs, appear to emerge also from the same, and go to the sides of the body, between the mantle and foot.

The single supra-œsophageal ganglion, which we propose to term visceral, on account of its nerves being in connexion with the ganglia of the viscera, is round, scarcely so large as the olfactory, and sessile on the under surface and anterior border of the right branchial ganglion, where it is in contact with the pedial. Four nerves (*j, k, l, m*) issue from this ganglion; these go to the organs of reproduction, to the stomach, to the two hearts, and to the branchiæ, and can be traced, as has been just pointed out, into ganglia of the sympathetic system belonging to these several organs. The only other nervous trunk in connexion with

## DORIS.

these supra-oesophageal centres, is that which forms the third or great oesophageal collar (*i*). It is stout, being composed of three parallel cords, and closely invests the oesophagus.

The infra-oesophageal ganglia are two pairs, symmetrically disposed on the buccal mass: the large or buccal ones (*e, e*) are, as above related, connected, by means of a collar, with the cerebroid; they are elliptical, and united across the median line by a stout commissure. They give off laterally, and in union with the collar, two pairs of nerves, the sixteenth and seventeenth, which are distributed to the buccal mass. The eighteenth is a small pair which passes off backwards from the same ganglia to the base of the tongue, and is joined by the buccal filament of the sympathetic. To the front of the buccal are attached the gastro-oesophageal ganglia (*f, f*), which are very small, and give off three pairs of nerves. The smallest of these, the nineteenth, is given to the salivary glands; the twentieth supplies the top of the oesophagus, and communicates with the oesophageal sympathetic plexus. Lastly, the two nerves constituting the twenty-first pair, by far the largest of the three, are continued down the under surface of the oesophagus, nearly parallel with each other, communicating by slender filaments with a fine open network of nerves and ganglia upon that tube, and unite with two of the largest ganglia of the sympathetic system of the stomach.

The great supra-oesophageal ganglia vary a little in some species from those of *D. tuberculata*, from which the above description is mainly taken. In *D. pilosa* and *D. repanda* they are as distinct from each other as in that species, being only slightly altered in relative position. In *D. Johnstoni*, *D. coccinea*, *D. bilamellata*, and *D. aspera*, the cerebroid and branchial are completely fused into one mass, which in some of these species is elongated in the antero-posterior direction; in others, obliquely. No material variation takes place in the origin and distribution of the nerves. The visceral ganglion is present in all.

The sympathetic or organic nervous system is extensively developed in *D. tuberculata*: it is more or less demonstrable in the skin, the buccal mass, and in all the internal organs. It consists of a vast number of minute but distinct ganglia, varying in size and form, the larger quite visible to the naked eye, of a bright orange colour, like the ganglia round the oesophagus, and interconnected by numerous delicate white nervous filaments, arranged in more or less open plexuses or networks. This beautiful system is, at several points, as already indicated, connected with both sets of cephalic ganglia, and is most completely displayed on the digestive organs, forming at the cardiac extremity of the stomach a distinct circular chain or belt of ganglia and commissures. Ganglia and nerves, forming an extensive plexus, are also well developed on the reproductive organs, and the branchio-cardiac (Pl. 1, fig. 2 *g*) portion of the sympathetic is equally conspicuous.

Extensive traces of the sympathetic system have been detected in several other species, as well as in *D. tuberculata*; but on account of their diminutive size, the ganglia and connecting nervous plexuses could not be followed with the same degree of accuracy as in that species.

The eyes of *Doris* are generally connected to the optic ganglia each by a very short nerve, and are situated below the skin. In *D. bilamellata*, *D. aspera*, and *D. pilosa*, the nerve is, however, somewhat elongated. The eye (Pl. 2, fig. 14) evinces considerable development, being furnished with a well-rounded black pigment-cup, having within the orifice a spherical crystalline lens, which has in front an arched cornea, and the whole is enveloped by a transparent membranous capsule. The auditory capsules (fig. 15) are always supplied with

## DORIS.

numerous otolithes, and rest upon the cerebroid ganglia immediately behind the attachment of the optic ganglia.

The skin in most species is tough and coriaceous, and is of a spongy or cellular structure internally: the cloak in all the British species is stiffened with numerous imbedded, calcareous spicula, having a more or less symmetrical arrangement. Spicula are also observable in the foot, in the tentacles, and in the branchiæ. The under surface of the foot, and the upper surface of the cloak, as before stated, are covered with vibratile cilia. The branchial plumes and dorsal tentacles are also furnished with them.

The ova of *Doris* (Pl. 3, fig. 8) are generally arranged in transverse rows, imbedded in a transparent gelatinous belt, attached by one of its edges to some foreign substance, and coiled one or more times into a pretty regular cup- or vase-like form. In one division of our second section, however, the ova are contained in a fine, depressed, close, thread-like coil. The ova are very numerous. On a moderate computation, there cannot be less than 50,000 in a single patch of spawn (Pl. 3, fig. 7) of *D. tuberculata*; and when we take into account that all the individuals are prolific—the sexes being combined—and that each deposits two or three patches in a season, it is evident how vast must be the number of young produced each year, a single pair bringing forth probably 300,000 eggs.

Most of the species deposit their spawn in spring, and shortly afterwards the yolk, which is contained within a delicate, transparent, membranous shell or chorion, may be observed changing form (Pl. 3, figs. 9, 10, 11, 12). The time required to mature the embryo varies in different species, and probably in the same species, under different circumstances. The late Dr. John Reid\* found that the spawn of *D. bilamellata* was hatched in fourteen days, and a patch of the spawn of *D. tuberculata*, removed by us from the rocks very soon after deposition, came to maturity in fifteen days. The whole of the ova in the same mass of spawn, however, are not hatched simultaneously, their successive liberation sometimes extending over a period of several days. As the character of the embryo and mode of development are extremely similar throughout the Nudibranchiate Mollusca, to avoid repetition, we purpose extending this account of the embryology to the whole order, and may therefore here state that we have ascertained that the spawn of *Polycera quadrilineata* is hatched in ten or twelve days; that of *Doto coronata* in eight or ten, of *Hermæa dendritica* in nine, and of *Eolis punctata* in ten or eleven. In all these cases the spawn was kept in the house, and probably the consequent increased temperature may have hurried the development. Professor Nordmann† found the development of his *Tergipes Edwardsii* to require from sixteen to twenty days.

In *Doris tuberculata* the chorion is elliptical, and generally contains one yolk, sometimes two or three: at first the yolk‡ is round, and nearly fills the chorion (Pl. 3, fig. 9); it soon becomes a little elongated, with one end diagonally truncated (fig. 10); the truncated end then becomes bilobed, each lobe exhibiting an imperfect spiral, and having its margin ciliated (figs. 11, 12). The now animated being is seen to rotate within its prison. Shortly, the lobes, which are placed in front, enlarge, and a fleshy process—the rudimentary

\* Ann. Nat. Hist., v. 17, p. 388.

† Ann. des. Scien. Nat., 3d ser., v. 5, p. 144.

‡ The progressive cleaving or breaking up of the yolk has been minutely described by Dr. Reid. Loc. cit.

## DORIS.

foot (figs. 11 *e*, 12 *e*)—is observed to develop itself a little behind them on the median line. A shell (figs. 11 *c*, 12 *c*) closely investing the inferior portion of the embryo, the lobes and rudimentary foot being uppermost. The shell rapidly increases, and assumes a nautiloid form; afterwards the foot displays, attached to its posterior surface, a circular operculum (fig. 13 *d*), which is opposed to the mouth of the shell. The lobes (fig. 15 *f*) now expand into two large, flattened, ovate appendages, with very long vibratile cilia around the margins, and the larvæ are at length mature. The whole mass of spawn now presents the utmost animation; hundreds of these busy atoms are seen, each within its transparent membranous cell, rotating with great agility and ceaseless perseverance, the cilia all the while vigorously vibrating on the margins of the outstretched lobes. The membranous chorion, which by this time has become enlarged, ultimately gives way, no longer able to resist the perpetual struggle within, and the liberated larva, wending its way through the shattered shreds of the general envelope, boldly trusts itself to the open, trackless waters, where, doubtless, thousands and tens of thousands perish ere they find a fitting resting place; some being swept away by resistless currents, others falling a prey to ever watchful and innumerable enemies.

On close examination, the shell of the larva is found to be of excessive delicacy, exquisitely brilliant, and so transparent that its exact form is not very easily made out. In all the species it is of a nautiloid character, with the spire of scarcely one volution, and invariably a little twisted to one side. It is, in fact, the commencement of the ordinary testaceous covering of a gasteropod, and were its growth continued, it would assume the usual spiral form. In *D. tuberculata* the shell is rather shallow, while, in some of the *Eolididæ* (Fam. 3, Pl. 1, figs. 5, 6), it is of considerable depth; and in *Eolis olivacea*, it (fig. 9) may be said to be altogether without a spire. Weak acetic acid destroys the shell; but the operculum remains unaffected by it. There can be little doubt, therefore, that the former is calcareous, and the latter horny.\*

The larva is somewhat opaque, and is enveloped in a very wide, thin, delicate, and transparent membrane or cloak (Pl. 3, fig. 15 *m*), which partially lines the shell, being in contact with it at the mouth, and at the bottom where the retractor muscle (*n*) is attached to it. This is a strong band, with the end in contact with the shell, a little enlarged; it passes upwards, and is lost in the midst of the larva, which, in *D. tuberculata*, is so opaque that the various parts are not easily determined. In *Eolis coronata*, however, they can be readily distinguished. In this species, as well as in *Doris tuberculata*, *Doto coronata*, and *Eolis picta*, the ciliated oral lobes are large; but they are small in *E. olivacea* (Fam. 3, Pl. 1, fig. 9), *Hermæa dendritica* (Fam. 3, Pl. 40, fig. 7), and *Polycera quadrilineata* (Fam. 1, Pl. 22, fig. 11). The mouth (Fam. 1, Pl. 3, fig. 15 *g*) is situated between and a little behind these lobes, and is a mere circular opening of considerable dimensions: the œsophagus passes downwards from this opening, and is a rather wide and straight tube, which, suddenly swelling out, is formed into a rounded, in some species an elongated, pyriform, well-marked stomach (*h*). The intestine (*i*) is considerably constricted, and leaves the stomach at the extremity opposite to the cardiac

\* The same is the case with the larva of *Aplysia*: on placing it in weak acetic acid, air bubbles were immediately formed, and on account of their rapid generation, the shells were jerked about. In a short time these latter entirely disappeared, leaving exposed the animal enveloped in its cloak. The operculum was not in the least changed.



## DORIS.

end, and bending upwards, runs almost parallel to the œsophagus, and terminates at one side not far from the base of the oral lobe and close behind an oval sac (*k*), probably the incipient genitalia. The alimentary canal is ciliated within, and particles of matter may frequently be seen rotating in the interior of the stomach, influenced by the action of the cilia.

Besides the parts just described, there is always a rounded, yellowish, and opaque mass (*j*), sometimes divided into two, which is situated within the spiral portion of the shell, and in contact with the stomach. This, according to M. Vogt, is the liver; and he is probably correct. On each side, near the commencement of the œsophagus, is a rather conspicuous circular vesicle (*l*), containing a distinct nucleus; the vesicle and nucleus being very distinct in *Eolis coronata*. They have been considered by most writers on the subject to be the auditory capsule and otolith; a view first adopted by Sars, and in which we are disposed to agree, having observed the enclosed nucleus or otolith to vibrate within its capsule in the larva of *Aplysia*.

In the mature larva, the foot is of considerable dimensions; and the operculum, which is attached to its posterior surface, is so delicate and transparent, that much care is required to observe it accurately. Under favorable circumstances it is seen to be circular, extending considerably beyond the fleshy support; and indistinct circular lines of growth may occasionally be observed upon it.\* We have failed to detect the operculum in *Dendronotus arborescens*, *Eolis picta*, and *E. olivacea*. Our failure, however, in these cases may have arisen from the excessive tenuity and transparency of the parts.

Besides the large, locomotive, vibratile cilia of the oral lobes, the action of which is under the control of the larva, the whole surface of the exposed parts is covered with minute cilia, whose vibrations never cease. These cilia are most probably for respiratory purposes, and may also assist in bringing food to the mouth, as stated by M. Vogt.

When the larva is at rest, the oral lobes are pulled back into the shell, and the operculigerous lobe or foot, being drawn down, brings along with it the operculum, which closes the orifice; but when in action (figs. 14, 15), the whole of these parts project beyond the opening of the shell, the foot lying back against the spire; and the oral lobes inclining forward, their cilia commence to vibrate, and the larva, with the mouth of the shell upwards, moves through the water with lively action, sinking or rising, or advancing onwards at its pleasure.

We have not succeeded in tracing the development of the larva into the mature form; but it is not difficult to understand how this change is effected. When the larva is placed with the mouth of the shell downwards, the oral lobes in front (we are speaking particularly of *Eolis*), the anal termination of the intestine, and the oval sac representing the generative organs, will be found on the right side, close to the base of the oral lobe, and the operculigerous lobe or foot will be seen to extend backwards in a medium position, occupying the place of the crawling disc. Thus it is evident that the principal organs of the larva only require to be slightly modified in form, and it is changed into the mature animal, the shell and operculum being cast off, and the oral lobes either absorbed, or altered into a veil or oral tentacles.

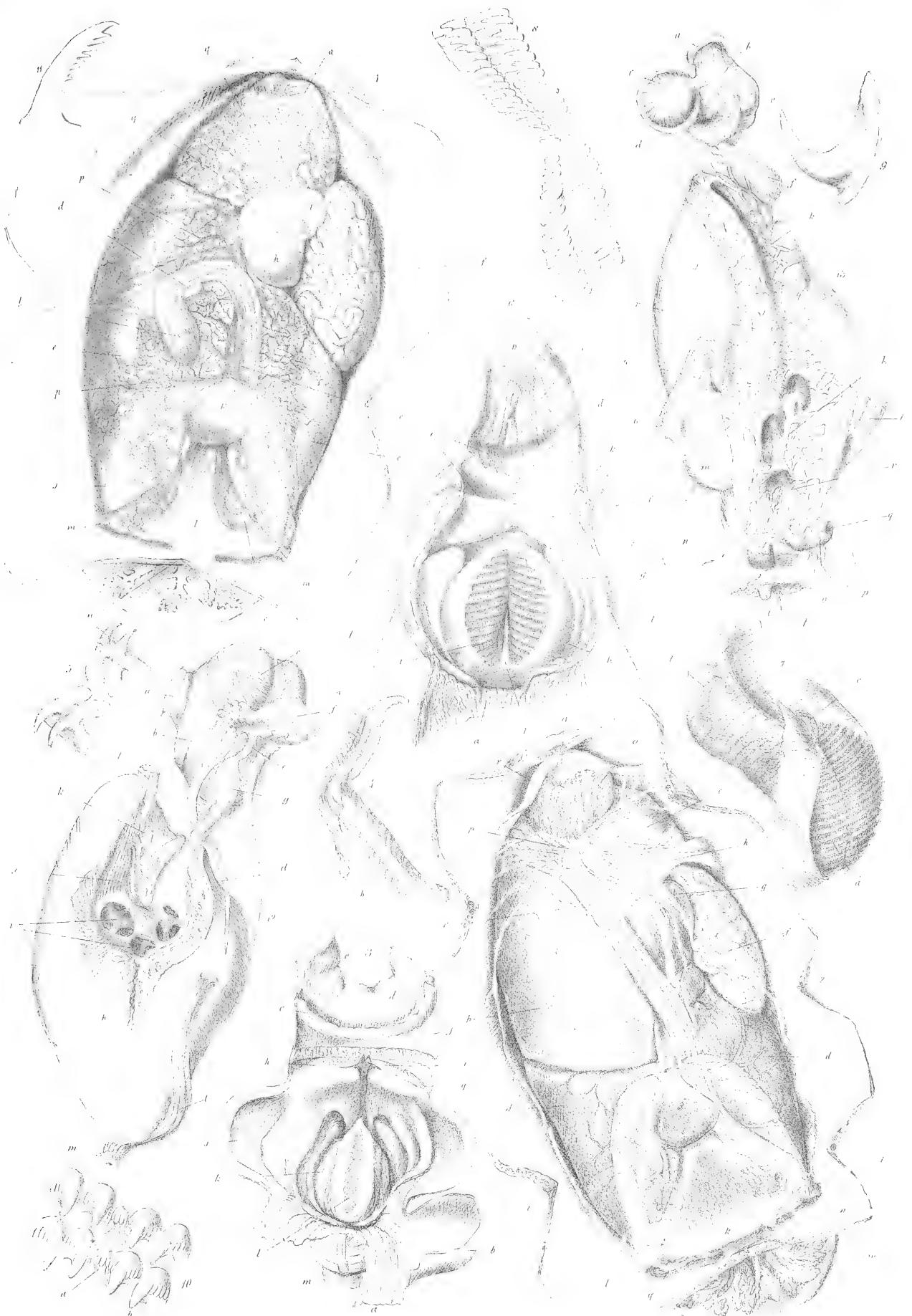
This view of the change of the larva into the mature animal is apparently verified by the investigations of Professor Nordmann, who has traced the transformations in a species closely allied to our *Eolis dispecta*.

\* Circular lines of growth are perfectly distinct on the operculum of *Aplysia*.

## EXPLANATION OF PLATES.

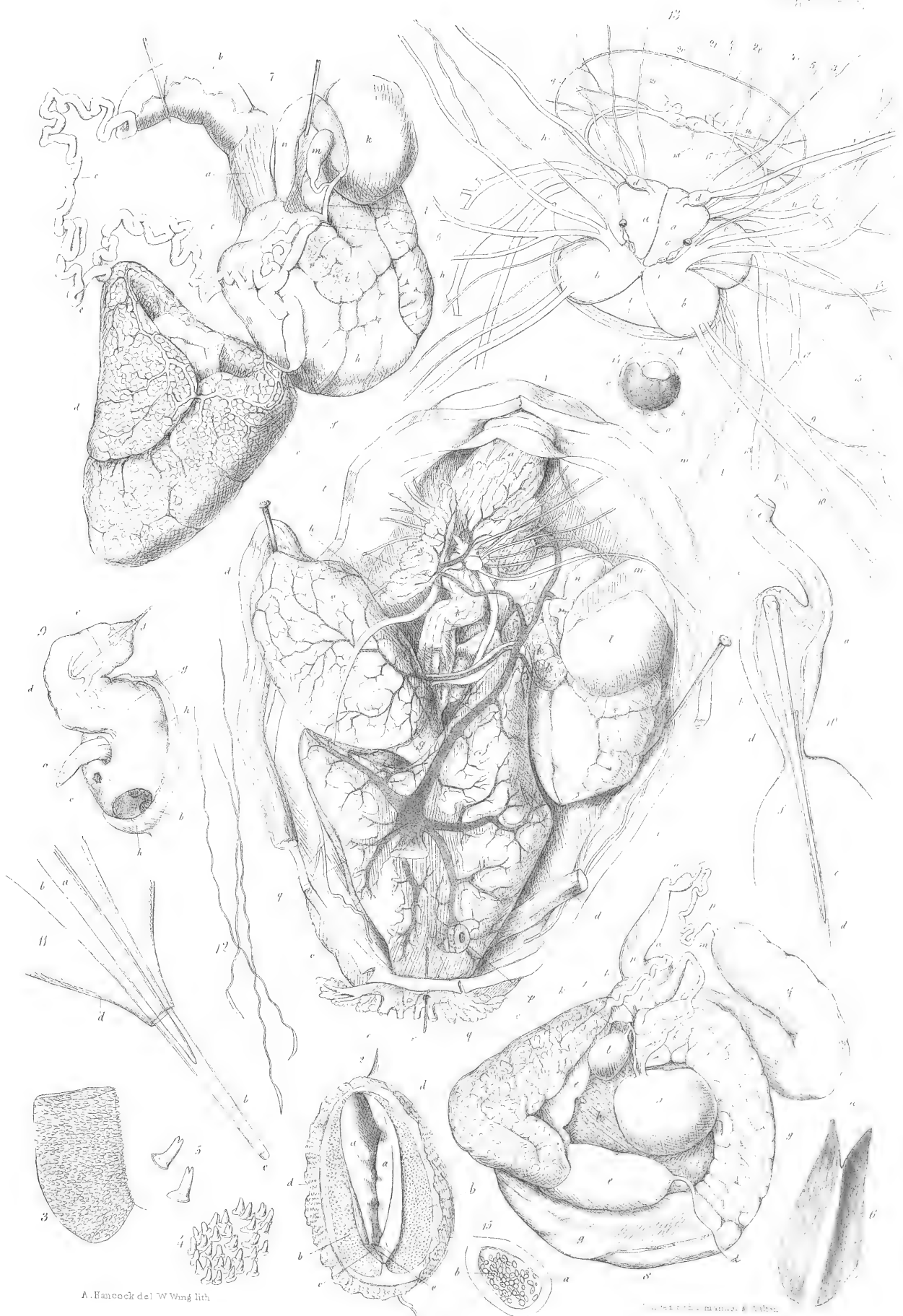
### PLATE 1.

- Fig. 1. General view of the viscera of *Doris pilosa*, the dorsal kin being laid open :—*a*, buccal mass ; *b*, portion of stomach ; *c*, intestine ; *d*, pancreatic organ ; *e*, *e*, liver ; *f*, mucus-gland in connexion with the female channel ; *g*, portion of testis ; *h*, spermatheca ; *i*, accessory spermatheca ; *j*, pericardium ; *k*, ventricle ; *l*, auricle ; *m*, *m*, lateral trunk-veins passing into the auricle from the skin ; *n*, trunk-vein from the branchiæ leading into the auricle ; *o*, portal heart ; *p*, *p*, upper wall of renal organ exhibiting network of vessels ; *q*, folliculated gland-like body apparently connected with the vascular system.
2. General view of the viscera of *D. tuberculata* seen from above :—*a*, buccal mass ; *b*, stomach, exhibiting on its surface a network of nervous filaments, with a few minute ganglia, being a portion of the sympathetic system ; *c*, intestine ; *d*, *d*, liver, with the principal arterial trunks of the liver and renal organ seen on the surface ; *e*, retracted penis ; *f*, mucus-gland belonging to the female channel ; *g*, spermatheca ; *h*, vagina leading from the external orifice to the same ; *i*, pericardium ; *j*, ventricle, with the aorta passing from the apex in front ; *k*, auricle ; *l*, *l*, lateral trunk-veins leading from the skin to the auricle ; *m*, trunk-vein leading from the branchiæ to the auricle ; *n*, portal heart, opening into pericardium ; *o*, gland-like body in connexion with the vascular system ; *p*, supra-oesophageal ganglions with the nerves passing from them ; *q*, branchial ganglions of the sympathetic system ; *r*, retractor muscles of the channel of the mouth.
  3. View of the buccal cavity of *D. pilosa*, from above :—*a*, œsophagus ; *b*, membranous crop at the commencement of the same ; *c*, oral opening ; *d*, outer lip ; *e*, inner lip ; *f*, channel of the mouth ; *g*, buccal lip ; *h*, prehensile collar in connexion with the same ; *i*, rudimentary jaws ; *j*, walls of the anterior portion of buccal cavity ; *k*, fleshy support of the tongue ; *l*, tongue ; *m*, external sac within which the tubular portion of the tongue is lodged.
  4. Side view of the tongue of *D. pilosa*, the fleshy support being removed :—*a*, anterior prehensile portion ; *b*, posterior tubular portion.
  5. Portion of the tongue, more highly magnified, seen from above.
  6. View of the buccal cavity of *D. tuberculata*, seen from above :—*a*, œsophagus ; *b*, oral opening ; *c*, outer lip ; *d*, inner lip ; *e*, channel of the mouth ; *f*, buccal lip ; *g*, walls of buccal cavity ; *h*, fleshy support of the tongue ; *i*, tongue ; *j*, membranous septum dividing the anterior from the posterior portion of the tongue ; *k*, retractor muscles of the channel of the mouth ; *l*, *l*, retractor muscles of buccal mass.
  7. Side view of the tongue of *D. tuberculata*, without the fleshy support :—*a*, anterior portion ; *b*, posterior or tubular portion ; *c*, membranous septum dividing the two portions.
  8. Central portion of two rows of spines from the tongue of *D. tuberculata*.
  9. A single spine more highly magnified.
  10. Central portion of two rows of spines from the tongue of *D. repanda* :—*a*, central spine ; *b*, lateral spines.
  11. A single lateral spine more highly magnified.









A. Hancock del W Wing lith

ANATOMY OF LICHEN

Collected from the mountains of Mexico.

## DORIS.

- Fig. 12. Digestive organs of *D. pilosa*:—*a*, channel of mouth; *b*, buccal mass; *c*, gizzard-like portion of the same; *d*, salivary glands; *e*, œsophagus; *f*, membranous crop at the commencement of the same; *g*, dilated portion of the same; *h*, liver laid open, exposing the track of the alimentary canal; *i*, hepatic ducts opening into the anterior portion of the stomach; *j*, stomach; *k*, pancreatic organ opening into posterior portion of the stomach; *l*, *l*, intestine; *m*, anus.
13. Digestive and renal organs of *D. bilamellata*, the latter organ laid open:—*a*, channel of the mouth; *b*, buccal mass; *c*, muscular gizzard opening into the same; *d*, external sac for the reception of the tubular portion of the tongue; *e*, salivary gland; *f*, œsophagus; *g*, pancreatic organ opening into the stomach; *h*, *h*, intestine; *i*, anus; *j*, liver; *k*, *k*, renal organ laid open longitudinally to expose network of vessels on its walls; *l*, a bristle passed into the renal cavity through external orifice; *m*, ventricle of heart; *n*, auricle; *n'*, aorta; *o*, portal heart opening into pericardium; *p*, portion of the floor of pericardium attached to the margin of orifice leading into portal heart; *q*, orifice leading from pericardium into portal heart.

## PLATE 2.

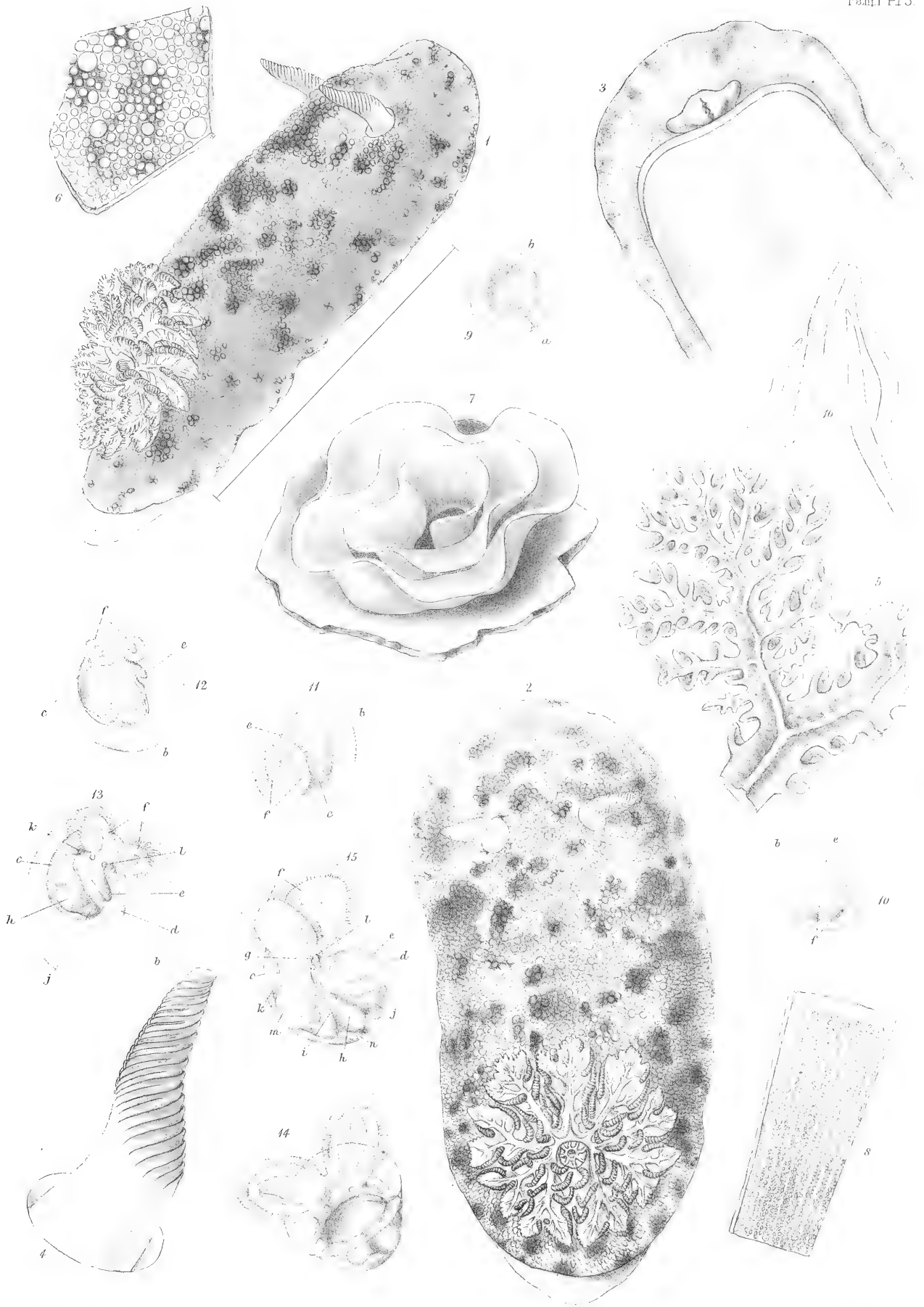
- Fig. 1. General view of the viscera of *D. tuberculata*, partially separated, the arterial system being injected:—*a*, buccal mass; *b*, gullet; *c*, stomach; *d*, *d*, intestine; *e*, anal nipple; *f*, liver mass; *g*, hepatic duct; *h*, salivary glands; *i*, pancreatic organ; *j*, retracted penis; *k*, *k*, the two portions of the mucus-gland in connexion with the female channel; *l*, spermatheca; *m*, copulatory channel or vagina, leading to the same; *n*, accessory spermatheca; *o*, root of the aorta, the heart having been removed; branches from the great systemic artery may be seen passing to all the viscera; *p*, portal heart; *q*, *q*, renal organ, with the hepatic or renal arteries lining and appearing through its upper wall; *r*, a bristle passed into the renal cavity through the external orifice; *s*, *s*, a glandular body apparently in connexion with the vascular system; *t*, the supra-œsophageal ganglia with various nerves passing off from them.
2. Entrance to the buccal mass of *D. pilosa*, seen in front, the channel of the mouth having been removed:—*a*, *a*, buccal lips; *b*, *b*, prehensile collar in connexion with them; *c*, the free extremities of the rudimentary jaws; *d*, *d*, portion of the lining membrane of the channel of the mouth.
3. A portion of the prehensile collar, showing the arrangement of the spines.
4. A group of the spines more highly magnified.
5. Two of the spines still more highly magnified.
6. The rudimentary plate or jaws entirely exposed:—*a*, their free extremities; *b*, the portion buried in the buccal lips.
7. Generative organs of *D. tuberculata*, removed from the body and unravelled:—*a*, channel of the penis leading to external orifice; *b*, retracted penis; *c*, *c*, testis; *d*, ovary spread over the liver; *e*, *e*, oviduct; *f*, dilated portion of it; *g*, the point where it communicates with the testis; *h*, *h*, semipellucid portion of the mucus-gland in connexion with the female channel; *i*, opaque portion of the same; *j*, female channel leading to external orifice; *k*, spermatheca; *l*, its duct leading to the oviduct; *m*, accessory spermatheca; *n*, vagina, or copulatory channel leading from external orifice to spermatheca.

## DORIS.

- Fig. 8. Generative organs of *D. Johnstoni*, spread out:—*a*, retracted penis; *b*, vas deferens; *c*, testis; *d*, oviduct as it leaves the ovary; *e*, *e*, dilated portion of the same; *f*, oviduct near to the point of its union with the testis; *g*, *g*, semipellucid portion of the mucus-gland; *h*, opaque portion of the same; *i*, female channel leading to external orifice; *j*, spermatheca; *k*, its duct leading to the oviduct; *l*, accessory spermatheca; *m*, copulatory channel or vagina; *n*, retracted penis-like organ in connexion with the stiletto; *o*, pouch of the stiletto; *p*, duct leading from the same to a glandular sac, *q*.
9. External view of the partially exerted generative organs of *D. Johnstoni*:—*a*, penis; *b*, external orifice of the female channel; *c*, vaginal orifice; *d*, penis-like organ in connexion with the stiletto; *e*, stiletto within its pouch; *f*, point of the same, partially protruded; *g*, duct leading from the pouch to the glandular sac; *h*, *h*, lip of the common orifice.
  10. The pouch and stiletto, as seen in the compressor:—*a*, outer pouch; *b*, inner ditto; *c*, *c*, stiletto; *d*, *d*, its sheath; *e*, duct leading to the glandular organ; *f*, portion of the retracted penis-like organ.
  11. The apex of the partially exerted penis-like organ much enlarged:—*a*, stiletto; *b*, *b*, its sheath; *c*, orifice at the point of the same; *d*, apex of the penis-like organ.
  12. Spermatozoa from the oviduct of *D. tuberculata*.
  13. Cerebral or cephalic ganglions and nerves of *D. tuberculata*:—*a*, *a*, cerebroid or sensorial ganglions; *b*, *b*, branchial ganglions; *c*, *c*, pedial ganglions; *d*, *d*, olfactory ganglions; *e*, *e*, buccal ganglions; *f*, *f*, gastro-oesophageal ganglions; *g*, first or anterior collar; *h*, second collar, or commissure uniting the supra- and infra-oesophageal ganglions; *i*, third, or great oesophageal collar; 1st pair of nerves go to the dorsal tentacles; 2d pair supply the channel of the mouth and lips; 3d pair go to the oral tentacles; 4th and 5th pairs pass to the channel of the mouth and lips; 5th pair likewise give off branches which go to form the anterior collar; 6th pair are the optic nerves; 7th pair the auditory; 8th, 9th, and 10th pairs supply the mantle; the 10th pair send a branch of communication to the branchial ganglia of the sympathetic system; 11th, 12th, and 13th pairs supply the foot; 14th and 15th pairs go to the sides of the body below the mantle; 16th and 17th pairs are lost in the buccal mass; 18th pair supply the tongue; 19th pair are given to the salivary glands; 20th pair supply the top of the gullet; 21st pair pass down the gullet, and are joined to the ganglia of the sympathetic system of the stomach; *j*, *k*, *l*, *m*, single nerves from the visceral ganglion; the first and last of these go to the sympathetic ganglions of the heart and branchiæ, the second to those of the generative organs, the third to those of the stomach.
  14. Eye of *D. repanda*:—*a*, optic nerve; *b*, pigment cup; *c*, general envelope; *d*, lens; *e*, cornea.
  15. Auditory capsule of *D. aspera*:—*a*, outer capsule; *b*, inner capsule, containing numerous otolithes.







A. Hancock del. W. Wing lith.

Ford & West Imp.

DORIS TUBERCULATA.

## Fam. 1, Plate 3.

### DORIS TUBERCULATA, CUVIER.

*D. elliptica*, subdepressa, flava vel auriantia, fusco griseove sæpè liturata; pallio tuberculis depressis, crebris, inæqualibus; branchiis 9 tripinnatis, effusis, intra foramen retractilibus: tentaculis labialibus tubercularibus.

*Doris tuberculata*, Cuv., in Ann. du Mus., v. 4, p. 469, pl. 74, f. 5.

Lam., Anim. s. Vert., 2d ed. v. 7, p. 463.

Johns, in Ann. Nat. Hist., v. 1, p. 50, pl. 2, f. 1, 2.

Macg., Moll. Anim. Aberd., p. 197.

For. and Hanl., Brit. Moll., v. 3, p. 563.

*argo*, Penn., Brit. Zool., v. 4, p. 43, pl. 22, f. 22.

Turt., Brit. Faun., p. 133.

Grant, in Edinb. Ph. Journ., v. 13, p. 198.

Flem., Brit. Anim., p. 282.

Dalyell, Pow. of Creat., v. 2, p. 294, pl. 42, f. 4—7.

*argus*, Stark, Elem. Nat. Hist., v. 2, p. 68.

Bouch. Chant. Catal. des Moll. du Boul., p. 40 ?

*pseudo argus*, Rapp, in Nova Acta Acad. Nat. Cur., v. 13, p. 519.

Bouch. Chant., Catal. des Moll. du Boul., p. 41.

*Britannica*, Leach, Syn. Moll. Gr. Brit., p. 19.

*Montagui*, Ibid., Syn. Moll. Gr. Brit., p. 18.

*mera*, Ald. and Hanc., in Ann. Nat. Hist., v. 14, p. 330.

*Hab.* Under stones and in crevices of rocks between tide-marks, common.

*Body* two or three inches long, but occasionally reaching to four or even five inches;\* breadth about half the length; of an elliptical form, nearly equally rounded at both ends. The colour is generally a lemon-yellow or buff-orange; but it is frequently variegated on the upper side with blotches of sage-green, pink, and grayish brown. It sometimes occurs of a very light sage colour, almost white, and young individuals may be procured quite white. The markings are also very variable: occasionally they are numerous and large, covering a great portion of the cloak; at other times they are small, distant, and irregular spots. Full yellow specimens are commonly seen without any markings. *Cloak*

\* A specimen of this size was got by Mr. Price, in North Wales, in the spring of 1852, and Sir J. G. Dalyell appears to have met with it nearly of the same dimensions.

## DORIS TUBERCULATA.

thickly covered with flattish, spiculate, unequal tubercles, the smaller ones being very numerous and much less than the others: it extends considerably beyond the foot, and has the margins rather thickish; the under side is smooth. *Dorsal tentacles* slightly conical, yellow, and strongly laminated above, smooth, transparent, and nearly colourless below. The laminæ are upwards of twenty, alternately large and small; the latter not extending so far forwards as the former. *Branchial plumes* nine, tripinnate, recurved, large and spreading; much undulated in outline, and forming an incomplete circle round the anus, open behind. They are transparent, obscure white, with a purple or lilac tinge at the edges, faintly freckled, and can be completely retracted within a cavity, the margins of which close over them. *Head* rather small, with two small tubercular oral tentacles. *Foot* broadish, rounded and grooved in front, less broadly rounded behind, and of a lemon-yellow or orange colour, with the liver appearing through the centre.

*Spicula* numerous, rather small in proportion to the size of the animal, fusiform, bent in the centre, and bluntly pointed at the ends, rarely with the surface slightly nodulous: those in the tubercles are small and more irregularly bent than the others. The heart pulsates about twenty-eight times in a minute.

*Doris tuberculata* is a well-known species, common on all parts of the British coast; and though not so plentiful as some of the smaller kinds, it is, on account of its conspicuous size, much more readily observed, and is often the only Nudibranch with which the casual visitors of our sea-coasts are acquainted. It is generally found among rocks about half-tide level, and from thence down to low-water mark. Its favorite resort is within the crevices or under the shelving portions of rocks, hung with small sea-weeds and zoophytes, and incrustated with sponges, on which it feeds. In such places its very beautiful spawn may frequently be observed in the spring or early summer, suspended in an inverted cup- or vase-form, winding into a spiral of about three volutions, with the margins slightly waved. It consists of a broad gelatinous riband attached by one of its edges. When uncoiled, we have found it to measure as much as nine inches in length and nearly an inch in breadth. The ova are placed in transverse lines united in pairs, and amount to about fifty thousand in one mass of spawn. More than one of these masses are generally deposited by the same individual in a season. M. Bouchard Chantereaux has found his *Doris argus*, which is probably a variety of this species, to produce a coil of spawn of twelve inches in length, and he reckons the eggs at eighty thousand. Dr. Johnston met with the spawn of *Doris tuberculata* winding round the stem of a tangle in a spiral frill, and Sir J. G. Dalyell figures a similar elongated spiral, evidently the spawn of this species.

This is a very sluggish animal, seldom changing place when kept in confinement, and crawling very slowly. In its contracted state, as it is usually seen amongst the rocks, it is an unshapely and unattractive animal, being frequently cramped up to suit the inequalities of the surface to which it adheres, and to which it holds so tightly that much force is required to remove it. When placed in a vase of sea-water, however, and its plumes allowed to expand, it is by no means devoid of beauty.

The range of this species is rather uncertain, as the synonyms of continental authors cannot be relied upon. It appears to be equally common on the northern and western shores of France as with us, but we have no decided evidence of its occurrence in the Mediterranean, as the species called *Doris tuberculata* by authors describing the productions of that sea is

## DORIS TUBERCULATA.

distinct from ours. We think that the *Doris tuberculata* of Lovén, found on the Norwegian shores, is also probably distinct, though very nearly allied to our species.

Figs. 1, 2. Side and back views of *Doris tuberculata*.

3. Anterior portion of the underside.

4. Side view of tentacle.

5. Enlarged view of portion of a branchial plume.

6. A portion of the mantle enlarged, showing the tubercles.

7. Spawn.

8. A portion of the same enlarged, showing imbedded ova.

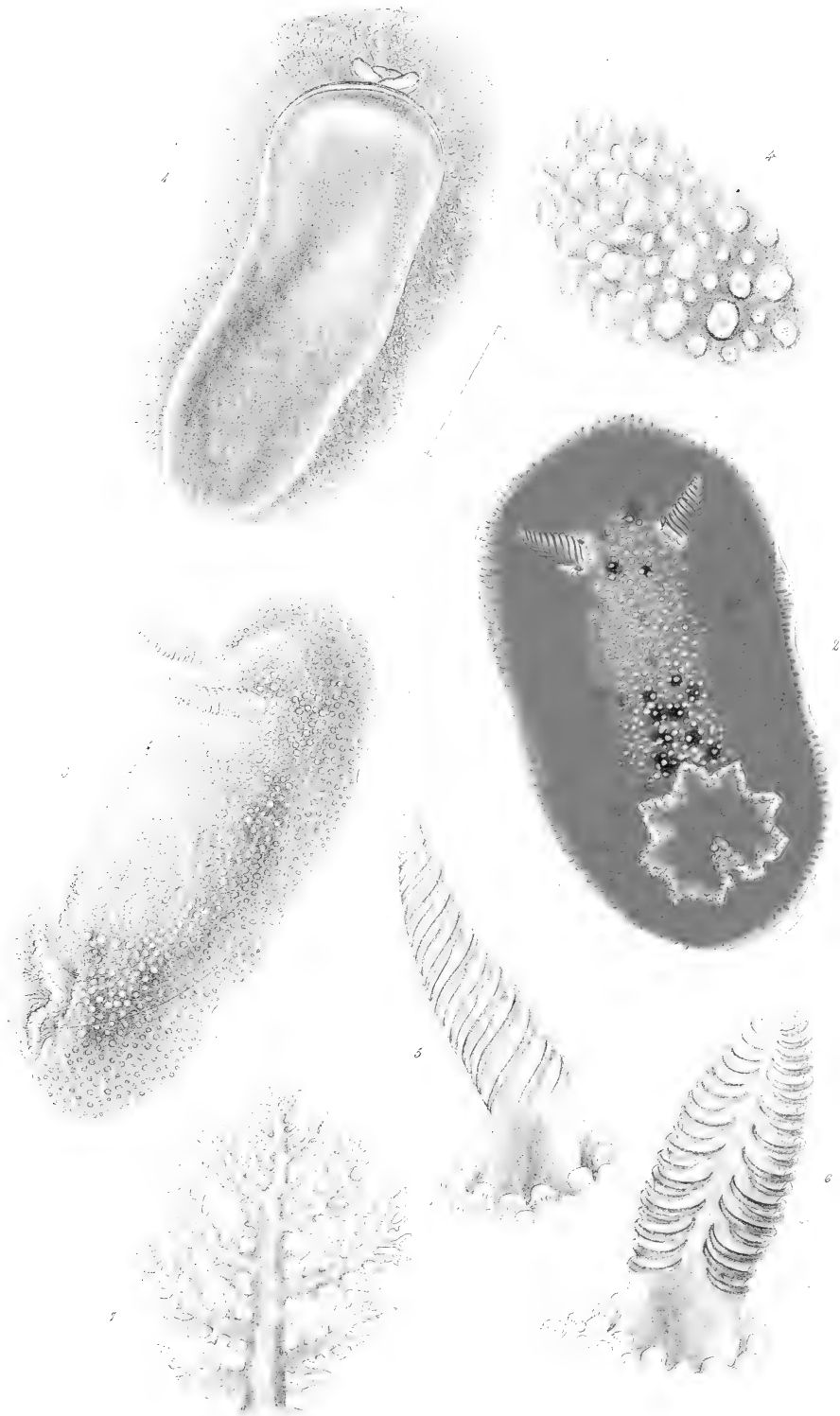
9. One of the ova much enlarged :—*a*, yolk ; *b*, corion.

10, 11, 12, 13, 14, 15. Embryos, showing progressive development :—*b*, corion ; *c*, shell ; *d*, operculum ; *e*, foot ; *f*, oral lobes ; *g*, mouth ; *h*, stomach ; *i*, intestine ; *j*, liver ; *k*, reproductive organs ; *l*, otolithes ; *m*, membranous envelope ; *n*, muscle attaching the embryo to the shell.

16. Spicula from the cloak.









## Fam. 1, Plate 4.

### DORIS FLAMMEA, ALDER and HANCOCK.

*D. coccinea*, aliquando purpureo-maculata: pallio tuberculis inequalibus, parvisculis: branchiis 9, tripinnatis, coccineis, non effusis, intra foramen retractilibus.

*Doris flammea*, Ald. and Hanc. in Ann. Nat. Hist. v. 14, p. 330.

*Hab.* Dredged up on *Pecten opercularis* in shallow water, Rothesay Bay.

*Body* about an inch long, and one half as broad, ovate, rounded at both ends, rather depressed, of a bright orange scarlet, occasionally blotched with purple. Cloak rather ample, covered with smallish, unequal, rounded, spiculose tubercles, becoming smaller towards the margin. Under side of the cloak minutely freckled with opake yellow. *Dorsal tentacles* rather large, tapering, orange, with ten or eleven scarlet laminæ and intermediate smaller ones. The orifices strongly tuberculated at the edges. *Branchiæ* not much spreading, but turned gracefully over, rather paler than the body, composed of nine scarlet plumes imperfectly three times pinnate, the posterior ones bilobed; retractile within a single cavity. *Head* small, with the sides produced into very short, obtuse, angular tentacles. *Foot* deep scarlet, rather darker than the body, rounded and slit transversely in front, rarely extending beyond the body behind; the sides nearly parallel.

This animal lived with us several days. It did not possess much activity. When at rest the cloak was occasionally much spread, giving it a rounded contour.

Of two specimens obtained, one was of a uniform scarlet; the other had a few blotches of purple, with an edging of that colour round the branchial plumes.

*Doris flammea* is very nearly allied to *D. tuberculata*; but, besides the difference in colour, the tubercles and branchiæ are smaller, and the dorsal tentacles larger and more numerously laminated.

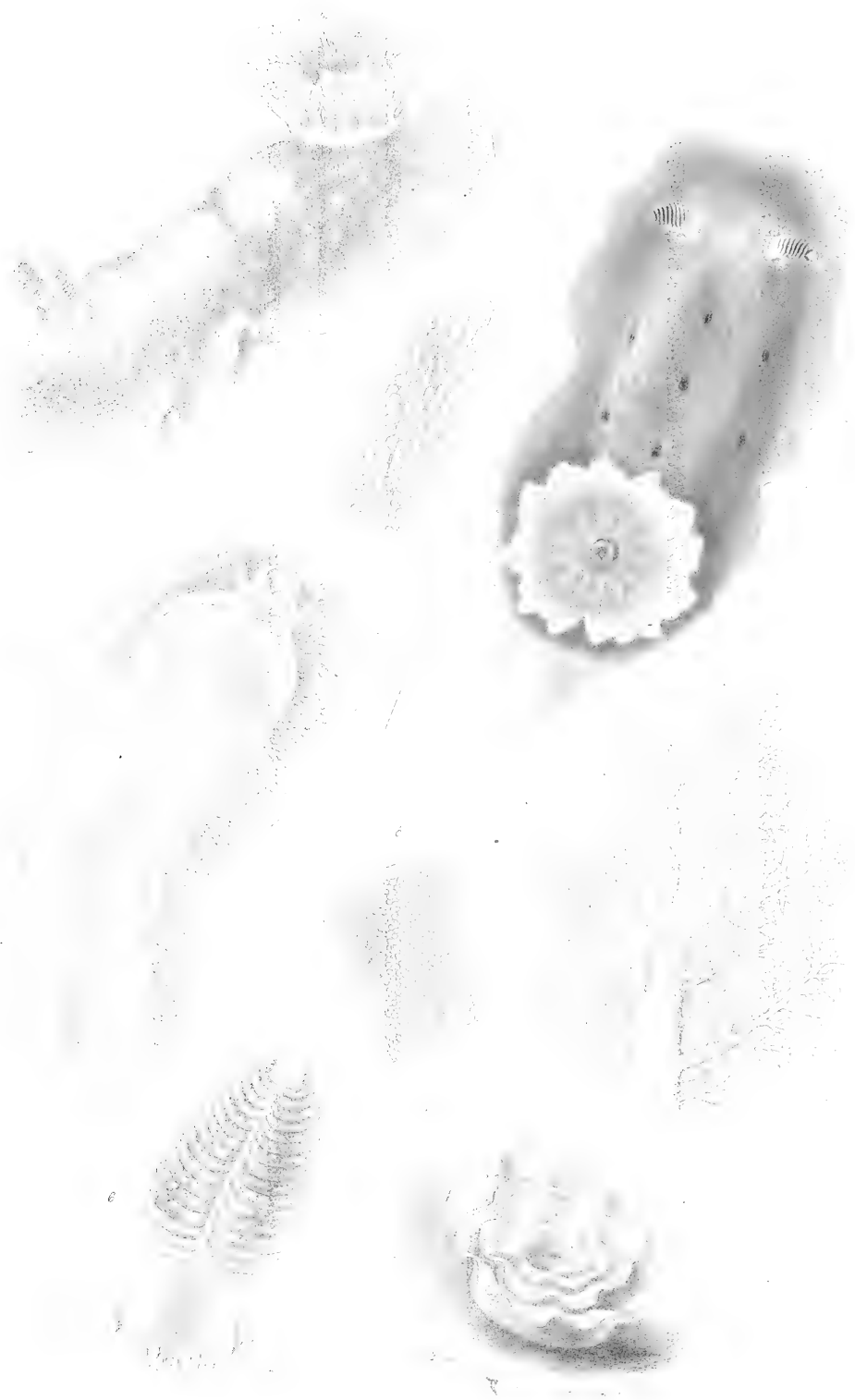
Fig. 1, 2, 3. *Doris flammea*, different views.

4. Portion of the cloak,	} more highly magnified.
5, 6. Dorsal tentacles,	
7. A branchial plume,	





1915.



## Fam. 1, Plate 5.

### DORIS JOHNSTONI, ALDER and HANCOCK.

*D. flavescens*, interdum maculis fuscis: pallio granulis minutis confertis: branchiis 15, tripinnatis, anum formâ calicis cingentibus, intra foramen retractilibus: tentaculis brevibus, crassis, fusco-maculatis.

*Doris obvelata*, Johns. in Ann. Nat. Hist. vol. 1, p. 52.

*Hab.* Among rocks near low-water mark. Berwick Bay, Cullercoats, and Newbiggin, Northumberland. Rothesay, Isle of Bute. Skerries, off the Dublin Coast, G. C. Hyndman, Esq. Scarborough, J. S. Bowerbank, Esq. Torbay.

*Body* an inch and a half or two inches long, ovate when at rest, but capable of great extension, rather convex on the back and depressed towards the sides, generally yellowish white or pale cream-coloured, occasionally of a buffish orange or lemon yellow. *Cloak* ample, closely covered with very minute, equal, linear, and spiculose tubercles, scarcely visible to the naked eye, and giving the cloak a granular appearance. It is blotched with pale brownish patches, and sometimes with a few small dark chocolate-brown or blackish spots, arranged in two or three longitudinal rows. The under side is smooth or very slightly granulated. *Dorsal tentacles* short, broad, and much rounded above, the apex projecting in a small nipple-like point; lamellated with 10 to 15 close-set plates, and covered with numerous dark brown spots; without sheaths, but having the margins of the cavity slightly raised and minutely tuberculated. *Branchial plumes* 15, tripinnate, yellowish white or sometimes pure white, encircling the brown tubular anus, and forming a beautiful blossom-like cup. They are retractile within a single cavity, the margin of which, when the plumes are extended, rises into a distinct rim; the plumes issuing from this, when viewed in profile, have a peculiarly elegant appearance. *Mouth* slightly probosciform, with two long, linear oral tentacles. *Foot* elliptical, yellowish, deeply grooved in front, the upper portion divided into two lobes below the mouth. It projects a little behind the cloak when the animal is in progression.

This species appears to be pretty generally diffused on our coasts, but nowhere common. It may, however, have been sometimes overlooked in consequence of its general resemblance, on a superficial view, to *D. tuberculata*. It was first described by Dr. Johnston from a small specimen found by one of the authors of this work while exploring with him the rocks in Berwick Bay. Dr. Johnston referred it to *D. obvelata* of Muller; but as we cannot agree with our friend in this opinion, we gladly dedicate the species to its talented describer, to whom we attribute the impulse that first led our studies in this direction. Muller describes his *Doris obvelata* to be covered with unequal convex papillæ, and the cloak veined beneath; the branchiæ he calls a confused serrated lobe, and the oral tentacles auriform lobes. Now in this species the tubercles are equal, nearly linear, close, and much smaller than those of

## DORIS JOHNSTONI.

*D. obvelata*, if we may judge from the figure; the under side of the cloak is never veined: one of its chief peculiarities is the beautiful and regular cup formed by the branchial plumes; and the oral tentacles are slender and linear, more so indeed than in any other species with which we are acquainted.

The spawn of *Doris Johnstoni* is smaller and more waved at the margins than that of *D. tuberculata*. It is of the same buff or yellowish colour. The cup formed by it has four coils, and the ova are placed rather irregularly. It is deposited in the months of May and June on the under side of stones near low-water mark.

Fig. 1, 2, 3. *Doris Johnstoni*, different views.

4. Portion of the cloak more highly magnified.
5. A branchial plume.
6. Dorsal tentacle.
7. Spawn.
8. A small portion of the same, showing the ova.







## Fam. 1, Plate 6.

### DORIS REPANDA, ALDER and HANCOCK.

*D. depressa*, lactea: pallio expanso, granulato, serie maculorum luteorum alborumve utrinque ornato: branchiis 5, parvis, tripinnatis, intra foramen retractilibus.

*Doris repanda*, Ald. and Hanc. in Ann. Nat. Hist. v. 9, p. 32.

*Hab.* Among rocks between tide-marks. Cullercoats, Whitley, and Newbiggin, Northumberland. Scarborough, *J. S. Bowerbank, Esq.* Oban, Argyleshire, *J. A. Roundstone, Connemara, W. Thompson, Esq.* and *Professor E. Forbes.*

*Body* above an inch long, elliptical, of a pure, waxy, semitransparent white. *Cloak* widely expanded, covered with small, distant, obtuse, and rather inconspicuous opake white tubercles, which gradually slope into the outline of the cloak at their bases. An irregular row of opake white or sulphur yellow angular spots runs down each side at a short distance from the margin of the cloak, which is thin and broad, extending much beyond the foot, and marked on the under side with slender white nerve-like lines much divided towards the margin. *Dorsal tentacles* issuing from slightly marginated and scalloped or tuberculated apertures. They are opake white or yellowish, beautifully laminated with about twelve or thirteen plates, and surmounted by a short, blunt point. *Branchiæ* small in proportion to the size of the animal, consisting of five imperfectly tripinnate transparent white plumes; the three anterior ones elegantly formed and distinct, the posterior deeply divided and irregular, making it difficult to determine their number. They are retractile within a single cavity. *Mouth* small, with two flat tentacular appendages, united above so as to form a sub-quadrangular veil. *Foot* narrowish, white, tinged with salmon-colour in the centre from the liver appearing through. It is rounded and strongly grooved in front, with parallel sides, and extends a short way beyond the cloak behind.

The pure waxy whiteness of the cloak, and the row of opake spots down each side, which are constant characters in this pretty species, serve at once to distinguish it from its congeners. Though found in some widely distant localities, it appears to be rather local, and by no means so generally diffused as some of the other Dorides. It is not rare, however, on the Northumberland coast, and may always be found on certain spots. We have not succeeded in obtaining its spawn, but think it probable that its breeding season is either in winter or early spring, at which season we have not had many opportunities of examining the coast.

Figs. 1, 2, 3. Different views of *Doris repanda*.

4. A portion of the cloak, much magnified.

5. A branchial plume, highly magnified.

6, 7. Different views of a dorsal tentacle.

8. Spicula from the cloak, much magnified.







## Fam. 1, Plate 7.

### DORIS COCCINEA, FORBES.

*D. coccinea*, nigro maculata : pallio granulis minutis confertis : tentaculis obtusis, brevibus, latè laminatis, lutescentibus, brunneo-maculatis : branchiis 10, pinnatis, parvis, erectis, rubris, intra foramen retractilibus.

*Doris coccinea*, Forbes, in Report Brit. Assoc. for 1843, p. 133.

*Hab.* Under stones and rocks between tide-marks ; not uncommon on the Cornish Coast.

*Body* rather above half an inch long, a little depressed, elliptic oblong, with the sides nearly parallel. *Cloak* not extending much beyond the foot, of a bright scarlet colour, generally sprinkled with small black spots, and thickly covered with very minute spiculate tubercles of nearly equal size ; under side of the same colour as the upper, without markings. *Dorsal tentacles* stout, short, and clavate, yellowish, blotched with brown ; transparent towards the base ; they have about ten broad laminae, deeply cleft and widely separated in front, and spreading much on each side, above which the tentacle is terminated by a slender projecting stile with an obtuse apex. The apertures are without sheaths, but surrounded by pale, opaque, yellow tubercles, larger than those on the other parts of the cloak, with a few intermediate dark brown or black markings : the tubercles are also larger, and of the same yellow colour between the tentacles, uniting them by an indistinct band. *Branchiæ* very small, forming a small, almost complete circle, consisting of ten slender, upright, sharp-pointed, and simply pinnate plumes of a red colour, paler than the cloak, and inclining to pink ; the two posterior plumes are smaller than the rest, and appear to arise from the base of those next to them. The whole are retractile within a small cavity. *Oral tentacles* long, linear, and slender, tapering towards the points. *Head* tubular, rounded in front, with the lips fleshy. *Foot* reddish flesh-coloured, with a long, narrow, purplish stain in the centre, from the liver appearing through. It is rounded and cleft transversely in front, with the upper lamina notched in the centre ; the posterior extremity is pointed, and extends a little beyond the cloak when the animal is crawling.

This handsome species was first sent us from Polperro on the Cornish coast by Mr. R. Q. Couch, and afterwards by Mr. Cocks from Falmouth. On a recent visit to the latter place, we found it not uncommon there in the month of June, and, with the exception of *D. tuberculata*, it was then the only species observed on the rocky parts of the coast.

We have ascertained, by a comparison with Professor Edward Forbes's drawings, kindly lent us for the purpose, that this is the species mentioned in his 'Report on the Ægean Mollusca,' under the name of *Doris coccinea*. We hesitate, however, to unite it with the *Doris* found by the same distinguished naturalist in the Isle of Man, and described in the 'Annals of Natural History' (vol. v), as *D. argo*. The latter will much more likely prove to

## DORIS COCCINEA.

be our *D. flammea*. Dr. Leach also describes a "*Doris coccinea*, Montagu MSS," in his unpublished work on 'British Mollusca,' which is probably identical with ours. The description is too imperfect to found a decided opinion upon, but the colour, the number of plumes, and its having been found on the "Coasts of Devon and Cornwall," warrant us in coming to this conclusion. If our conjecture is right, Montagu would appear to be the discoverer of this species, and it is fortunate that we are able to preserve the name given by him. We did not find a specimen of this among Dr. Leach's mollusca, preserved in the British Museum.

Our species might also be considered the *Doris rubra* of D'Orbigny, found on the French coast at Rochelle, did not the very peculiar character of the branchiæ, as described and figured by that naturalist, forbid our uniting them. In most other respects they perfectly agree.

In many of its characters *Doris coccinea* comes very near to *D. Johnstoni*, particularly in the minutely tuberculated surface of the cloak, and in the form of the oral tentacles. It is nevertheless perfectly distinct; never growing to a quarter the size of the latter, and always readily distinguished from it by its colour, and the simple, upright, small plumes. The colour of this species is pretty constant, varying only slightly in intensity, though one instance has occurred to us in which it was of a dull yellow, with only a faint tinge of red.

The spawn is deposited on the under side of stones in the month of June, and consists of a narrowish white riband, attached by its lower edge, and forming a coil of one and a half or two volutions; the upper margin is *smooth*, without undulations: the ova lie about ten abreast.

The spicula of this species are smooth, long, slender, and of various sizes; they are pointed at the extremities, and slightly swelled towards the centre, where they are a little bent.

Figs. 1, 2, 3. *Doris coccinea* in different positions.

4, 5. Side and front view of a tentacle.

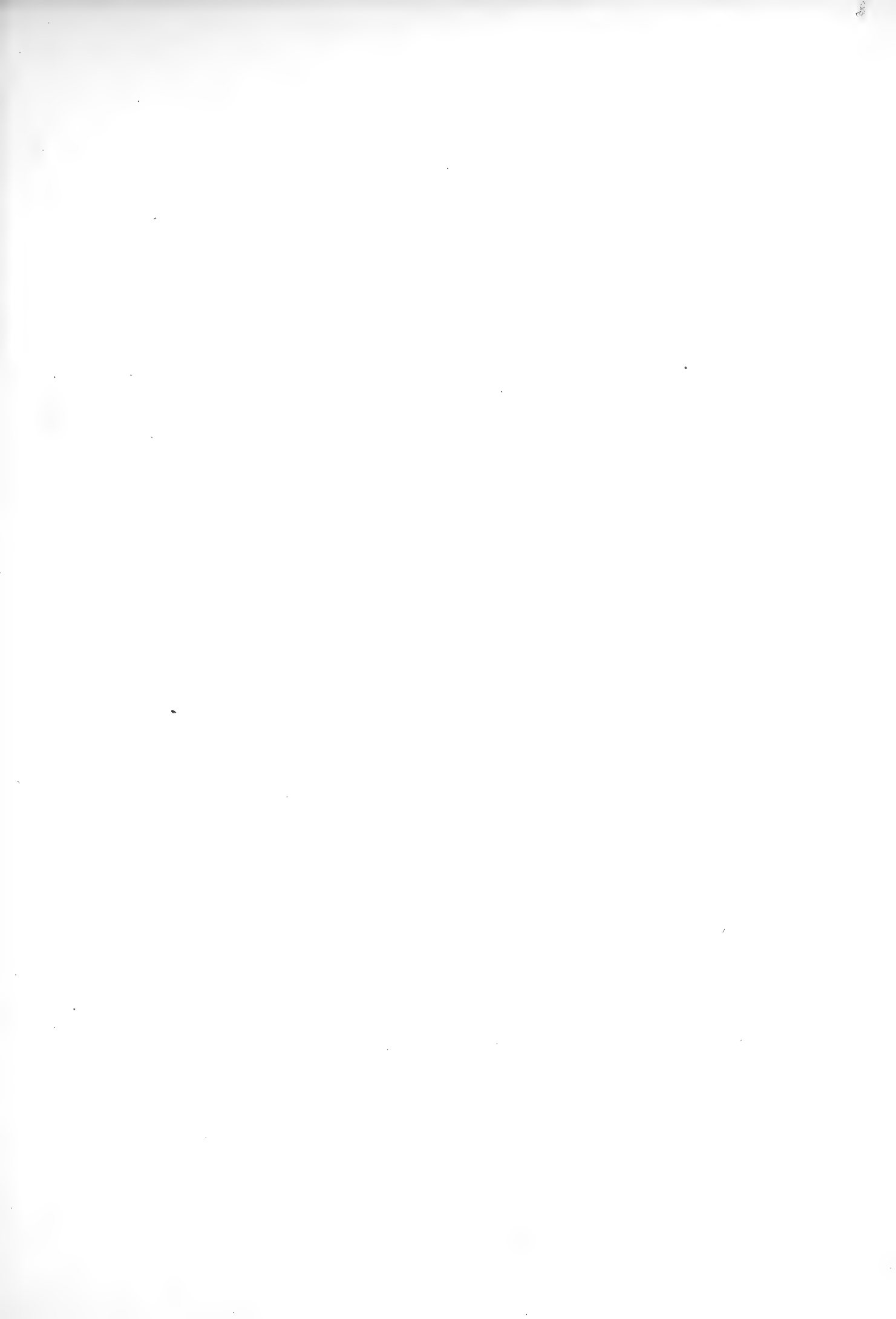
6. A branchial plume.

7. Tubercles of the cloak.

8. Spicula.

9. Spawn.

10. A small portion of the same, showing the ova.





A Hancock del, in Lithotint by A Holmes

C. H. Mandel's Patent.

DORIS PLANATA



## Fam. 1, Plate 8.

### DORIS PLANATA, ALDER and HANCOCK

*D.* valdè depressa, elliptica: pallio amplo, luteo-, fusco-, et rufescente-liturato, tuberculis inæqualibus, crebris: tentaculis dorsalibus subclavatis: tentaculis labialibus linearibus: branchiis 7, parvis, discoloribus, intra foramen retractilibus.

*Doris planata*, Ald. and Hanc. in Ann. Nat. Hist. v. 18, p. 292.

*Hab.* Dredged in Lamlash Bay, Isle of Arran. *J. A.*

*Body* nearly an inch long, elliptical, very much depressed. *Cloak* large and flat, thin at the edges, and extending much beyond the foot; thickly covered with obtuse, warty tubercles, mostly small but of very unequal sizes, the largest ones being arranged at irregular intervals on each side of the back. The prevailing colour is reddish brown, interspersed with dull lemon-yellow and purplish brown; the whole sprinkled with minute dark brown spots. The tubercles in many places, especially near the centre of the back, are tipped with opake white. Along each side of the back there are a few irregular patches of dull yellow, marking the position of the larger tubercles, and between them the back has a darker shade of purplish brown. The under side of the cloak is of a dull lemon-yellow, sprinkled with a few small reddish brown spots; it is smooth, and marked with a delicate veining of anastomosing lines, producing a shagreened appearance. *Dorsal tentacles* stout, subclavate, yellowish; the laminæ about twelve or thirteen in number, marked with dark brown lines and blotches, and sprinkled with yellowish white; the lower part speckled with purple-brown. The tentacles are placed rather near together, and are without sheaths, the margins of the cavities being only a little produced and tuberculated. *Branchiæ* very small, retractile within a large cavity. They consist of seven imperfectly tripinnate plumes, rather pointed at the top, and of a very pale fawn colour, strongly blotched with opake yellowish white and dark brown, giving them a pied appearance. *Head* very indistinct and scarcely visible, except when the mouth is protruded. *Oral tentacles* long, linear, rounded at the ends, and usually held in a slightly curved position. *Foot* rounded in front, much narrower than the cloak, and ending posteriorly in an obtuse point, which is seldom extended beyond the cloak. It is of a deep lemon-yellow, fading into a brownish tint towards the centre, where the liver appears through in a reddish brown patch. The front is deeply grooved transversely—the groove extending more round the sides than usual—and the upper lamina is notched in the centre.

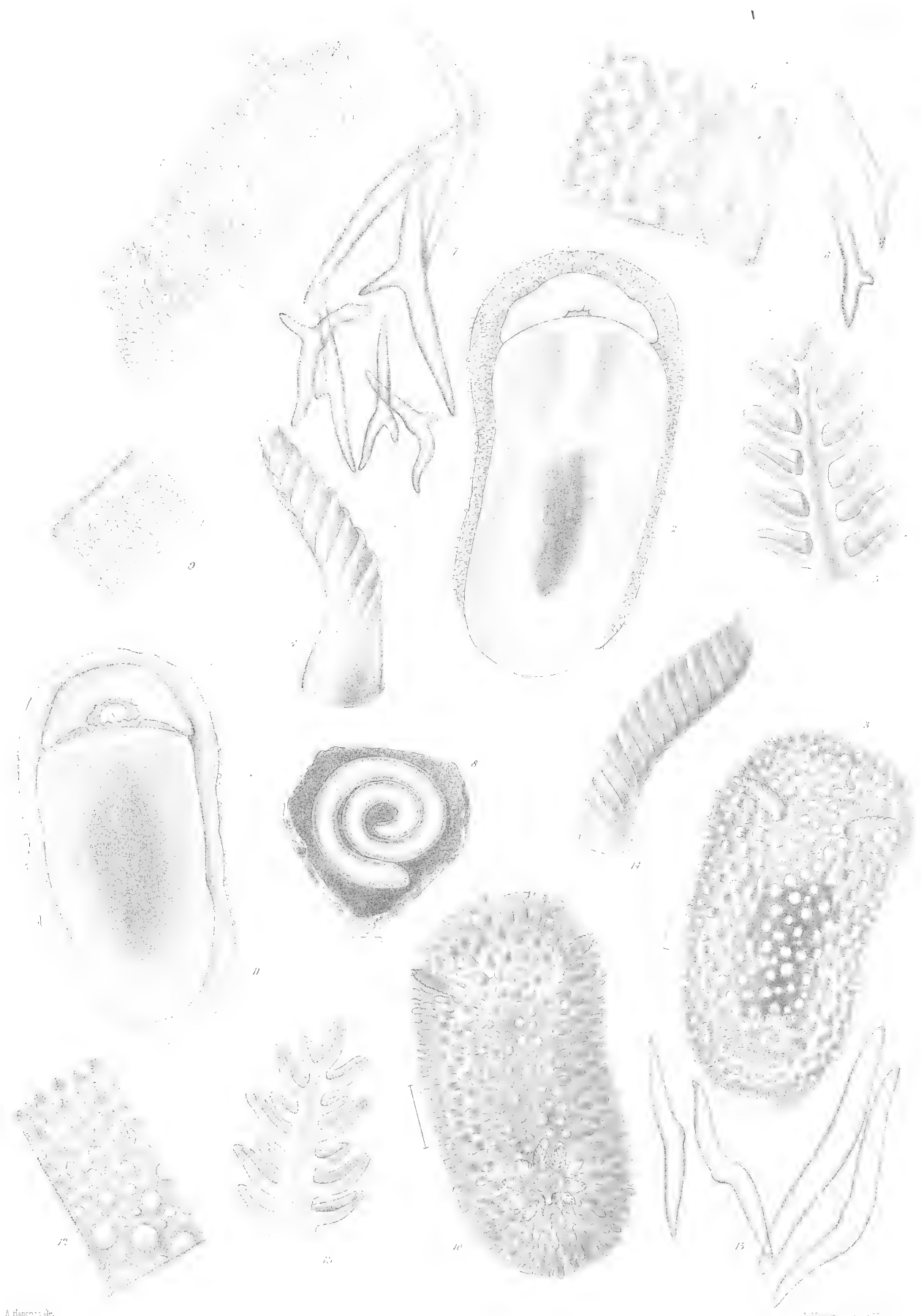
One of the chief peculiarities of this interesting *Doris*, compared with others of the same division, is its flatness, which gives it a good deal the appearance of a large *Planaria*. *Planaria*-like, too, it changes its form with great facility, sometimes drawing itself up when at rest into a nearly circular disc. The edges of the cloak are usually held in an undulated position.

## DORIS PLANATA.

This *Doris* cannot be confounded with any other known British species. Perhaps its nearest ally is the *Doris testudinaria* of the Mediterranean. The individual from which our drawings were taken was dredged on a scallop bed in shallow water in Lamlash Bay, and occupied the interior of an old shell of *Pecten opercularis*. The spicula were not examined, as we were unwilling to destroy our single specimen for that purpose.

- Figs. 1, 2, 3. *Doris planata*, different views.  
4. A branchial plume, more highly magnified.  
5. A portion of the skin, much magnified.  
6, 7. Side and front views of a dorsal tentacle.





A. Huxford.

Fig. 1-8 *DORIS ASPERA* Fig. 9-16 *DORIS PROXIMA*

Millimeter 1/2 1/4 1/8 1/16

## Fam. 1, Plate 9.

*Figs. 1 to 9.*

### DORIS ASPERA, ALDER and HANCOCK.

*D. ovata*, alba, pallio tuberculis validis, clavatis; branchiis 11 parvis, pinnatis, non retractilibus, anum haud propinque cingentibus; capite velato.

*Doris aspera*, Ald. and Hanc., in Ann. Nat. Hist., v. 9, p. 32.

For. and Hanl., Brit. Moll., v. 3, p. 567.

*Hab.* Among the rocks between tide-marks; common on the Northumberland and Durham coasts. Malahide, near Dublin; Ardrossan, Ayrshire, *J. A. Burghead*, Elgin, plentiful, *Geo. Murray, Esq.*

*Body* about four tenths of an inch in length, ovate, rather depressed, semi-transparent white; rarely of a yellowish tinge. *Cloak* not extending much beyond the foot, covered with rather distant, stout, clavate, flattened tubercles, of nearly equal size, interspersed with a very few smaller ones. The surface between the tubercles has an icy transparency from the spicula shining through: the tubercles are more opaque. *Dorsal tentacles* rather long, nearly linear or slightly tapering, a little bent backwards, with nine or ten rather distant laminæ which have usually a yellowish tinge; the basis of the tentacles are smooth and colourless: apertures smooth, without sheaths. *Branchial plumes* eleven, small, simply pinnate, (with five or six pinnæ,) transparent white; the anterior ones longest, the posterior pair very short, often scarcely shewing themselves above the tubercles. They are set at a little distance from the anus, leaving a small area. *Head* with a semicircular veil, smooth at the margin. *Foot* rather broad, rounded at the ends, and extending a little beyond the cloak behind, when the animal is in progression. It is of a transparent white, sometimes a little yellowish, with a small, oblong, reddish brown patch in the centre from the liver appearing through. There is likewise a pinkish shade on the back of the animal from the same cause.

The spicula are very variable both in size and form. The larger ones are arranged across the back, and diagonally at the sides, with a few of a slightly waved form running completely round the cloak at a little distance from the margin. Small spicula are clustered into the tubercles radiating at their base. Their usual shape is fusiform, obtusely pointed at the ends, and a little bent in the centre, where there is generally a spur or branch, but many of the smaller spicula, especially in the branchiæ and the margin of the cloak, are crucial or dagger-shaped, and this quadriradiate form is found, though less frequently, among the larger kinds. From the crowding of spicula in the skin, and the large hard tubercles, the animal feels firm and harsh to the touch.

This *Doris* appears to be rather local, but is one of the commonest species on the north-

## DORIS ASPERA.

eastern coast of England, where it is found under stones near low-water mark; sometimes four or five under one stone. From its small size, it appears to have escaped the notice of naturalists, or it may have been passed over as the young of *D. pilosa*. We have few records of its capture on the western coasts, where its place seems to be taken by nearly allied species.

*Doris aspera* comes very near the *D. muricata* of Müller, from which it differs principally in its smaller size, rather smaller tubercles, and almost constant white colour. There is, however, a group of species in this section of *Doris* so nearly resembling each other, that it requires more detailed characters than those given by Müller to discriminate them. *D. fusca* of Fabricius (a white species), and *D. acutiuscula* of Möller, appear to be very nearly allied to *D. aspera*. Our *D. proxima* is also very closely related.

The *Doris aspera* of Macgillivray must be something different from ours, as he describes it as having two small oral tentacles and the branchiæ retractile. It was probably a very young white variety of *D. tuberculata*.

This is comparatively an active animal, more restless than most of its congeners. When kept alive for observation, it frequently floats inverted at the surface of the water, and, like most of the littoral *Dorides*, it is apt to creep out of the water, and, if left over night, will often be found dead and dried up in the morning on the side of the glass.

It spawns in May, June, and July. The spawn is deposited in a narrow coil of two or sometimes three volutions, and is from a quarter to four tenths of an inch in diameter. The eggs are white, and rather thinly scattered through the gelatinous envelope without apparent order.

Figs. 1, 2, 3. *Doris aspera*, different views.

4. A dorsal tentacle.
5. A branchial plume.
6. A portion of the cloak, much enlarged.
7. Spicula.
8. Spawn.
9. A portion of the same, shewing the arrangement of the eggs.

## Fam. 1, Plate 9.

*Figs. 10 to 16.*

### DORIS PROXIMA, ALDER and HANCOCK.

*D. elliptica*, flava; pallio tuberculis validis, ellipticis; branchiis 11 pinnatis, non-retractilibus, anum haud propinque cingentibus; capite velato.

*Hab.* Among rocks and sea-weeds between tide-marks. Birkenhead, *J. Price, Esq.*

*Body* half an inch in length, elliptic-oblong, not much depressed, of a deep yellow or orange colour, varying in some specimens to pale yellow or white. *Cloak* covered with stout, sub-clavate, or elliptical bluntly-pointed tubercles, set at a little distance apart, and mixed with smaller ones. The spicula appear through the skin, radiating from the tubercles. *Dorsal tentacles* linear, slightly enlarged above, and obtusely pointed, with about fifteen laminæ reaching nearly to the base of the tentacle. They are usually of an orange-colour, deeper in shade than the cloak. The margins of the cavities are smooth. *Branchial plumes* eleven, the two posterior ones on each side small, yellowish, simply pinnate; the pinnæ are about six in number, of irregular length, and the plumes abruptly pointed: they are set in a small circle scarcely so close to the anus as in the preceding species. *Head* with a broad veil, having a large opening for the protrusion of the mouth. *Foot* rather broad, a little truncated in front, and rounded behind; orange-yellow, the liver appearing through the centre of a purplish colour, and extending much forward. Anterior margin with a frontal lamina.

The spicula are of various sizes, fusiform, with blunt points, and more or less bent, with a short spur or tubercle at the bending, which is usually nearer one end. So far as we have seen, none of the spicula are crucial or triradiate.

This at first sight appears to be a critical species, approaching as it does in external characters very closely to *D. aspera*, with which we were at one time inclined to unite it, but a minute analysis brings out several points of difference which we think would alone justify us in considering it distinct; but the number and character of the lingual spines\* at once establish its right to rank as a species; indeed the tongue differs so widely from that of *D. aspera* and its allies, that some naturalists might be disposed to consider them generically distinct. The best external character is the form of the tubercles, which in this species are elliptical or fusiform and obtusely pointed at the top, and not flatly rounded as in *D. aspera*; the tentacles, too, have more numerous laminæ and are thicker towards the top, and the liver,

\* See Pl. 46.

## DORIS PROXIMA.

as seen through the foot, is of much larger volume and extends farther forward than in the other species. The character derived from the liver, in the different species of *Doris*, is very constant. In its general appearance *D. proxima* is rather larger, and usually of a much deeper colour than *D. aspera*. The latter, indeed, is almost constantly white, and in only one or two rare instances have we seen it of a yellowish hue.

Mr. Price, to whom we are indebted for the knowledge of this species, informs us that it is not uncommon on the shore at Birkenhead during the spring months, but was more abundant a few years ago, before the recent great alterations in that locality. It spawns about the latter end of February. "The ova are dull yellow, thickly scattered through a transparent riband, forming an oblong, angular spiral, very inconspicuous on the brown stones. The ova contain two, three, or four yolks each."

Figs. 10, 11. Back and foot views of *Doris proxima*.

12. A portion of the mantle much enlarged.

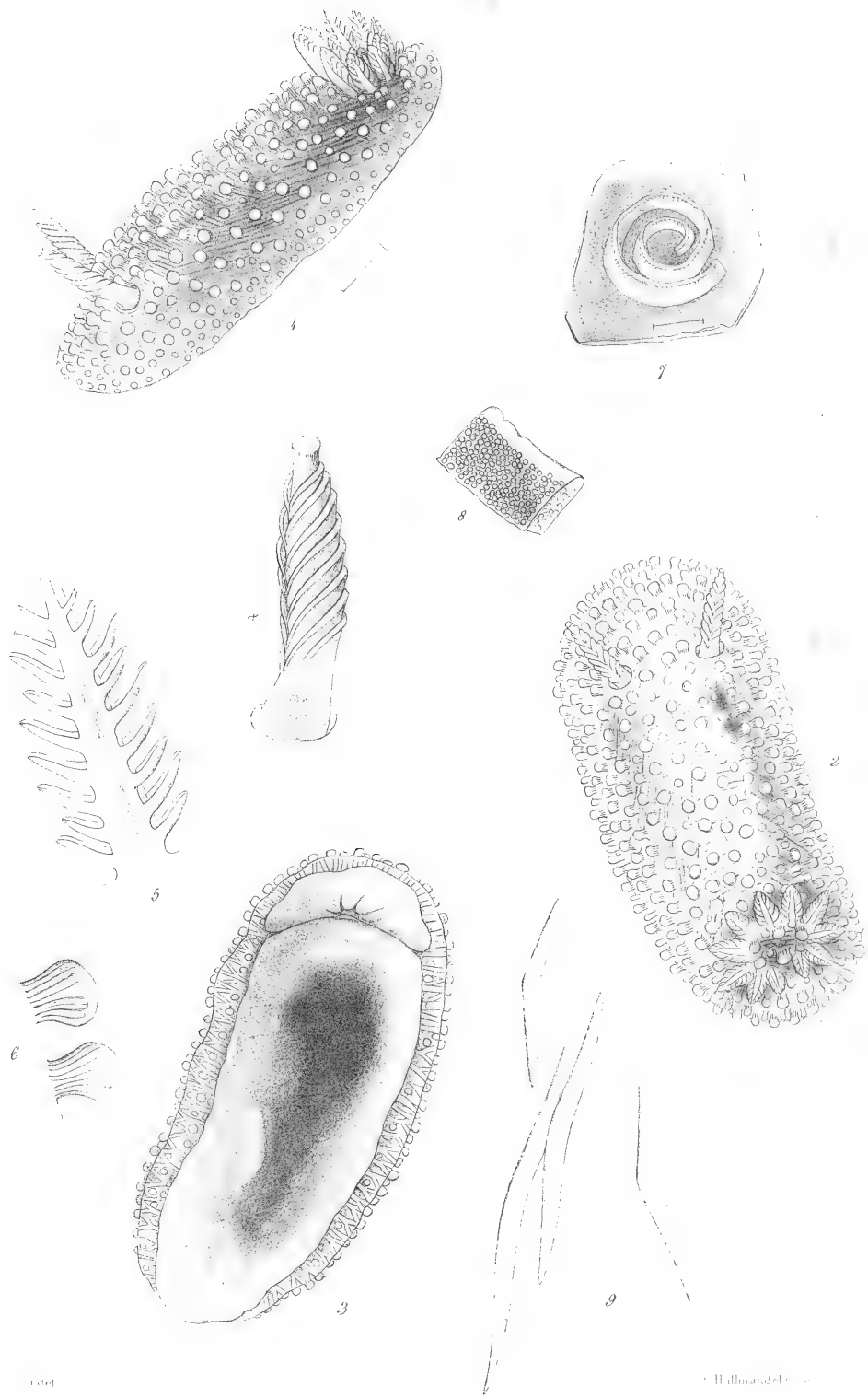
13. A branchial plume.

14. A dorsal tentacle.

15, 16. Spicula.







DORIS DIAPHANA.

## Fam. 1, Plate 10.

### DORIS DIAPHANA, ALDER and HANCOCK.

*D. alba*, pellucida: pallio tuberculis clavatis: branchiis 11, pinnatis, anum non propinque cingentibus.

*Doris diaphana*, Ald. and Hanc. in Ann. Nat. Hist. v. 16, p. 313.

*Hab.* Under stones near low-water mark, Meadfoot Sands, Torbay.

*Body* nearly half an inch long, and about half as broad, elliptic oblong, equally rounded at both ends, and not much depressed, of a pale yellowish white, very transparent, showing the intestines through the skin. *Cloak* extending a little beyond the foot all round, but rather more at the sides, covered with largish clavate tubercles, mostly of equal size, but having a few smaller ones amongst them on the back; those round the margin more thickly set and a good deal smaller. The spicula are seen through the transparent skin lying across the back, and sloping diagonally down the sides; those of the tubercles are small, and diverge towards the top. *Tentacles* nearly linear, pale yellow or yellowish white, transparent below, laminated with eight plates sloping very obliquely down behind; margins of the apertures nearly smooth, without sheaths. *Branchial plumes* eleven, simply pinnate, and partially retractile within a slight groove, set in an incomplete circle round the vent, leaving a tuberculated area within. *Head* with a large semicircular veil. *Foot* yellowish white, rounded in front and obtusely pointed behind, scarcely produced beyond the cloak, very transparent, showing the liver through the centre in a large, very dark, blackish-brown patch.

The spicula are unbranched, smooth and crystalline, a little bent in the centre, and tapering at the ends.

This *Doris* approaches nearest to *D. bilamellata*, but, besides the difference in colour and transparency, the branchial plumes are fewer, and arranged in a more circular form.

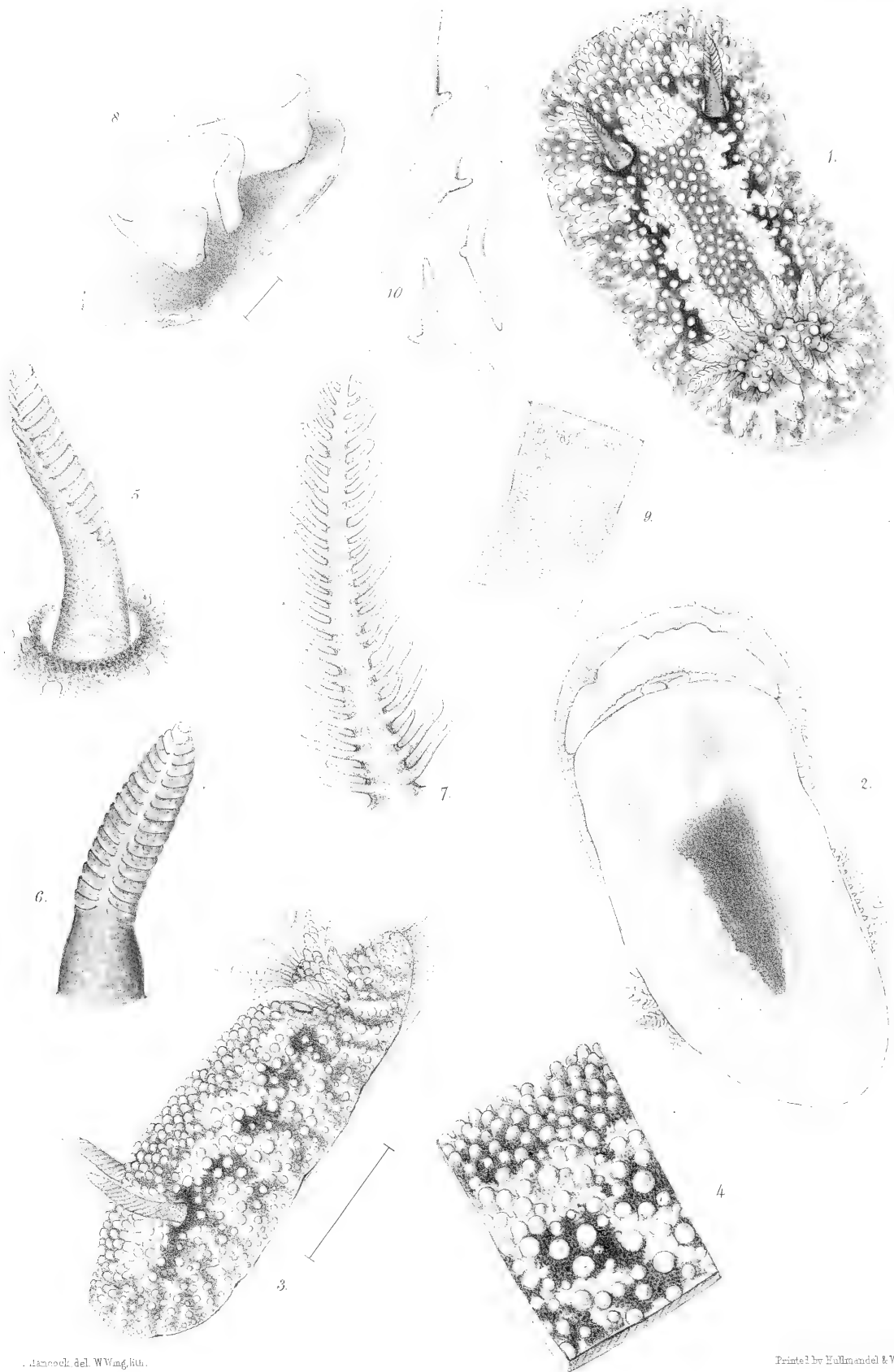
Two specimens were found under the same stone, in the locality above mentioned, about the middle of May, 1845, at which time they were spawning. The spawn is attached to stones, and forms a coil of two volutions of moderate width, sloping a little inwards at the upper margin.

Fig. 1, 2, 3. *Doris diaphana* in different positions.

4. Tentacle.
5. Branchial plume.
6. Tubercles of the cloak.
7. Spawn.
8. A portion of the same more highly magnified.
9. Spicula.







J. Hancock del. W. Wang lith.

Printed by Hollmandel & Walzen.

*DORIS BILAMELLATA.*

## Fam. 1, Plate 11.

### DORIS BILAMELLATA, LINNÆUS.

*D. elliptica*, albida, fusco longitudinaliter notata; pallio tuberculis magnis clavatis oblecto; branchiis numerosis, pinnatis, 20-29 parvis, circum anum remotè et transversè incurvatis; capite velato.

*Doris bilamellata*, Linn., Syst. Nat. 12th Ed., v. 1, p. 1083.

Johns., in Ann. Nat. Hist., v. 1, p. 53, pl. 2, f. 8.

Thomp., in Ann. Nat. Hist., v. 5, p. 86.

Macg., Moll. Anim. Aberd., p. 198.

For. and Hanl., Brit. Moll., v. 3, p. 567.

*fusca*, Mull., Zool. Dan. Prod., p. 229, no. 2768?

Idem, Zool. Dan., pl. 47, f. 6—9 (non desc.)

*verrucosa*, Penn., Brit. Zool., v. 4, p. 43, pl. 21, f. 23.

Turt., Brit. Faun., p. 133.

Flem., Brit. Anim., p. 282.

*vulgaris*, Leach, Syn. Moll. Gr. Brit., p. 19.

*Elfortiana*, Blainv., Bull. des Scien. 1806, p. 95, (sec. Leach.)

Leach, Syn. Moll. Gr. Brit., p. 20, pl. 7, f. 1.

*Leachii*, Blainv., Bull. des Scien., v. 13, p. 450, (sec. Leach.)

*affinis*, Thomp., in Ann. Nat. Hist., v. 5, p. 85.

*liturata*, 'Beck,' Möller, Ind. Moll. Grœnl., p. 5.

*obelata*, Bouch. Chant., Catal. des Moll. du Boul., p. 42.

*Hab.* On and under stones, between tide-marks, common.

*Body* from half an inch to an inch and a quarter long, and about half as broad when extended, of an elliptical form, nearly equally rounded at both ends. *Cloak* not extending much beyond the foot, covered with stout, not much crowded, clavate, strongly spiculate tubercles, of unequal sizes, being largest down the sides and about the branchial region, smaller and more thickly set on the centre of the back, and also becoming small towards the margin of the cloak. The colour is a dull yellowish white, marbled with umber brown; the brown markings forming three indistinct bands down the back; those on the sides are generally darkest in colour, but very much interrupted and irregular in form; that on the centre of the back is more uniform, but less intense. The brown usually extends round the bases of the tentacles, and the markings are mostly confined to the spaces between the tubercles. In some individuals they are very indistinct, and in others entirely wanting; but specimens without markings are comparatively rare. The under surface of the cloak is slightly granulated. *Dorsal tentacles* slender and nearly linear, swelling a little at the base, brown, finely laminated for about three quarters of their length in front; the upper laminæ only

## DORIS BILAMELLATA.

meeting behind, the rest gradually becoming shorter, so as to leave a wedge-shaped, smooth portion at the back of the tentacle. There are fourteen or sixteen laminae; the apex is small and not much produced. The margins of the tentacular cavities are plain, without tubercles. *Branchial plumes* small, simply pinnate, rather variable in number, reaching from twenty to twenty-nine in large individuals, but fewer in smaller specimens. They are placed round the vent, in a transverse elliptical groove, nearly straight in front and open behind, the ends being much curved inwards: the included space is strongly tuberculated. *Head* with a broad veil, having the margins a good deal waved and extended laterally. *Foot* rather broad, rounded in front, less broadly rounded and extending a little beyond the cloak behind, when the animal is crawling. It is of a yellowish white colour, the liver appearing through the centre of a purplish hue, but not very large.

The spicula of the cloak are smallish and rather stout, blunt at the points, and more or less bent in the centre, with usually a small inclined spur or branch at the bending. They are arranged in a stellate form round the tubercles. The spicula of the tubercles are very small.

The spawn forms a compressed coil of one, or, occasionally two volutions, cemented to the surface of stones and rocks by one of its margins; spreading at the top, and often a little curved outwards, so as to give it a vase-like outline. That of a large individual measured a quarter of an inch in height, and half an inch in diameter at the top; usually, however, it is not above half that size. The eggs are small and very numerous, showing a slight indication of a linear arrangement in their early stage of development, which afterwards disappears. We have taken the spawn in February, June, August, and November; but the principal breeding season is apparently in February, when large quantities of the spawn may be seen crowded together, forming patches of no inconsiderable size. In August, too, it has occurred to us in abundance. This species has, therefore, probably two breeding seasons, one in early spring, the other at the end of summer.

This is one of the most common Dorides on all our rocky coasts. It is occasionally met with in considerable numbers between tide-marks, especially in the spring; but a few individuals may be found in such localities all the year through. It varies exceedingly in size, in which respect two varieties are distinguishable, one nearly twice the size of the other, not, however, without occasional intermediate specimens. This disparity of size has led to the supposition that there might be two species, and they have been described as such, but after a careful examination of both kinds, we have been unable to fix upon any character to distinguish them, unless the increased number and greater development of the branchial plumes might be taken as specific; but we find this character, contrary to what is usual among the Nudibranchs, so very variable in this species, that we have not thought it safe to rely upon it, especially as the very peculiar arrangement of the plumes is the same in both, as well as the colour and markings of the cloak.

The *Doris affinis* of Thompson, a specimen of which, presented by our lamented friend, is now before us, was described from spirits, and the elongated character of the lateral tubercles, which was chiefly relied upon, appears to be owing to the state of preservation of the specimen. The same character is given as distinctive in the *Doris Elfortiana* of Blainville and Leach, which we take to be likewise a variety of *D. bilamellata*, judging from specimens in the British Museum, as well as from a living example sent us from the Frith of



## DORIS BILAMELLATA.

Forth, the original locality mentioned by Dr. Leach, where he states it to be very abundant. M. de Blainville says that he founded his genus *Onchidoris* on a specimen in the British Museum. It is rather remarkable that the specimen preserved in the Museum collection with the name of '*Onchidoris*, Blainv.' attached to it, should be an individual of *D. bilamellata*, in which no such characters as he establishes his genus upon are to be found. Besides, he figures in the '*Manuel de Malacologie*' an animal with the plumes retracted within a single cavity, according to his description. There is evidently a mistake somewhere with respect to this genus, and until a mollusk can be found with the characters assigned to the genus *Onchidoris*, it is desirable that it should remain in abeyance.

Dr. Johnston was the first, we believe, to recognise in the species now under consideration the *Doris bilamellata* of Linnæus, and it may be necessary to say a few words with respect to the propriety of adopting this view. We do not of course profess to unite our species with the *Limax bilamellatus* of the '*Fauna Suecica*,' which appears to have been an intestinal worm, but to that form of *Doris bilamellata*, in the 12th edition of the '*Systema Naturæ*,' to which the more detailed description belongs, stated, on the authority of J. G. Koenig, to be "frequent on stones" in Iceland. The description, '*anus transversus, supra postice corpus, ciliatus plumis simplicibus*,' very well characterises our species, and Müller's figure of *Doris fusca* in the '*Zoologia Danica*,' which he makes synonymous with *D. bilamellata*, Linn., undoubtedly represents it, though the description, as Professor Lovén has pointed out to us, belongs to a different species. The drawing was furnished by M. Koenig, from whom Linnæus received his specimens, and may therefore be taken as a correct representation of the Linnean *Doris bilamellata*.

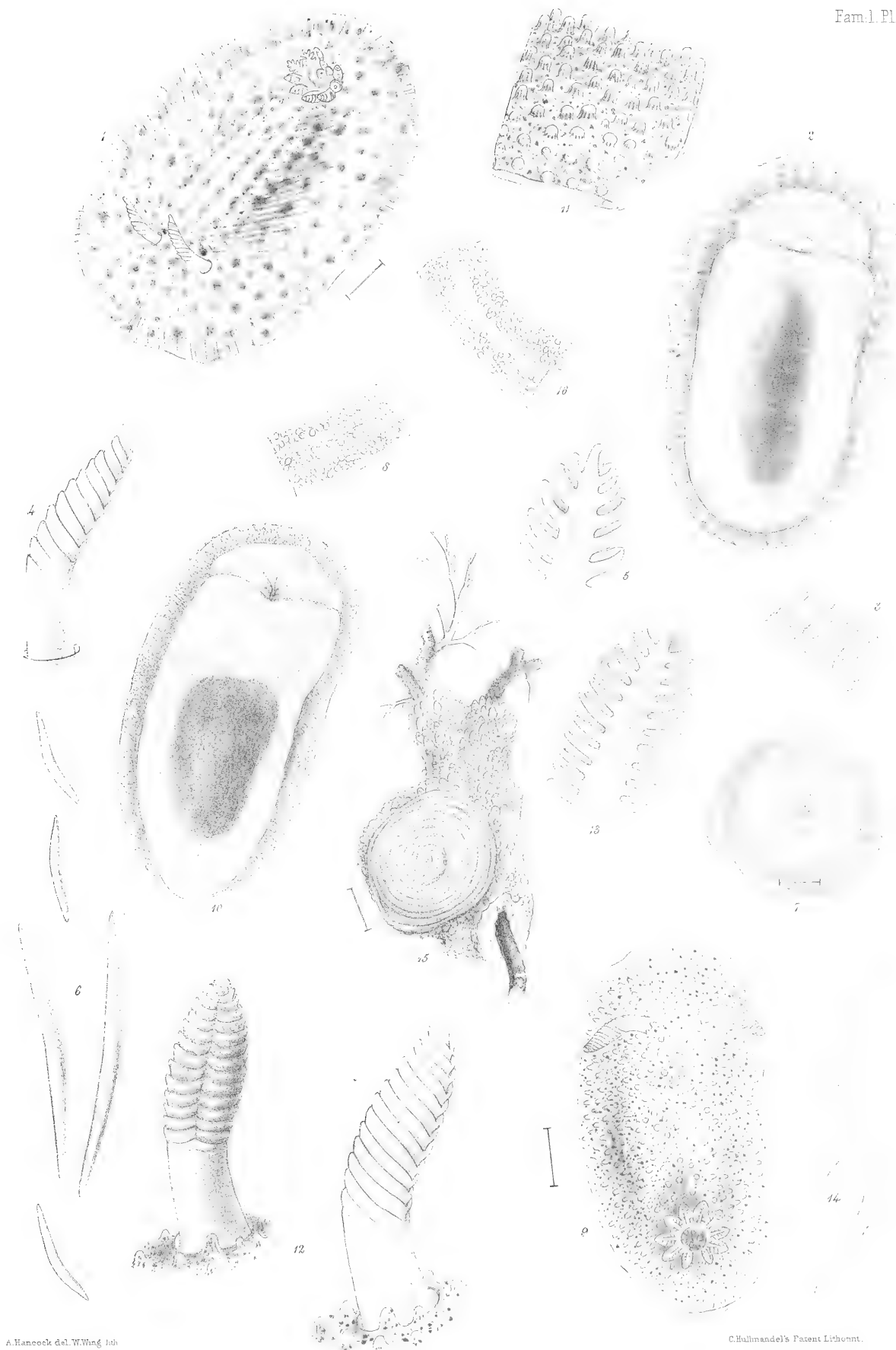
This species appears to be widely distributed through the seas of northern Europe, having been found in Greenland (Möller), Iceland (Koenig), and France (Bouchard). M. Lovén does not mention it in the Scandinavian Fauna, though we think it probable that it will be found on the Norwegian coast.

Fig. 1, 2, 3. *Doris bilamellata*, different views.

4. A portion of the cloak, much enlarged, showing the tubercles.
- 5, 6. Back and front views of tentacles.
7. Enlarged view of branchial plume.
8. Spawn.
9. A portion of the same more highly magnified, exhibiting the ova.
10. Spicula.







A. Hancock del. W. Wing lith.

C. Hallmandel's Patent Lithoent.

Fig. 1-8. DORIS DEPRESSA. Fig. 9-16. DORIS INCONSPICUA.

## Fam. 1, Plate 12.

*Figs.* 1 to 8.

### DORIS DEPRESSA, ALDER and HANCOCK.

*D.* valdè depressa, subpellucida, spiculosa; pallio lutescenti, rufo-maculato, papillis gracilibus, acuminatis, subremotis; tentaculis linearibus luteolis; branchiis 11, minutis, pinnatis, anum subremotè cingentibus.

*Doris depressa*, Ald. and Hanc. in Ann. Nat. Hist. v. 9, p. 32.

*Hab.* Under stones near low-water mark. Cullercoats and Whitley, Northumberland, *A. H.* Scarborough; Torquay, *J. A.*

*Body* from a quarter to three eighths of an inch long, and about two thirds as broad; thin, transparent, and very much depressed, of an elliptical or slightly ovate form, being nearly equally rounded at both ends. *Cloak* of a dull yellowish or sandy colour, sometimes inclining to rosy, and sprinkled with reddish, orange, or purple-brown spots, assuming an indistinct linear arrangement on the top of the back. It is covered with soft, linear, pointed papillæ, not very thickly dispersed over the surface, nor readily distinguishable: it is also filled and stiffened with large spicula, arranged symmetrically, in a transverse direction down the middle of the back, and diagonally at the sides, inclining from the head backwards; from the transparency of the skin, these spicula are very conspicuous, and give the cloak an icy or crystalline appearance. The back has a slight purplish shade, from the liver appearing through the cloak. *Dorsal tentacles* linear, slender, and tapering a little upwards; they are yellowish, with about ten laminæ. *Branchial plumes* ten or eleven, whitish, transparent, and almost colourless; simply pinnate, very small and inconspicuous, arranged in a nearly complete circle round the anus, and at a little distance from it: the circle is slightly broken behind, by the posterior plumes inclining inwards. The pinnæ are five or six in number, on each side the plumes. *Head* dilated into a semicircular veil. *Foot* broadish, truncated in front, rounded and not produced beyond the cloak behind. It is transparent and nearly colourless, but the liver, appearing through, forms a large, elongated, dark-brown patch in the centre.

This is the only *Doris* in which we have observed the eyes appearing through the skin in adult age. The spicula are of the usual form in *Doris*; those on the sides are remarkably large in proportion to the size of the animal, equalling in length nearly the transverse diameter of the body.

Our little *Doris*, in general appearance, so nearly resembles the figure given by D'Orbigny of his *Villiersia scutigera*, in Guérin's 'Magazin de Zoologie,' that at first sight it might be pronounced to be the same species; but an examination in detail shows differences that forbid our considering them identical. We have no hesitation, however, in stating our opinion, that

## DORIS DEPRESSA.

D'Orbigny's genus *Villiersia* is founded upon a *Doris* of this division imperfectly understood. It requires no great stretch of imagination to convert the spiculous armature of the cloak, in our species, into a calcareous shield, and the branchial plumes are so very minute, that it is difficult to recognise their plumose character. M. D'Orbigny describes and figures a circle of what he calls *mamillæ* (*mamelon*), corresponding to the plumes in our species, but does not assign them any function. What he calls the branchiæ were probably the ovigerous vesicles of a small crustacean of the *Lerneæ* tribe, which is parasitical on the nudibranchs, and, burying itself entirely under the skin, shows nothing externally but two ovate processes, that have the appearance of belonging to the mollusk itself.\* Under this view of the subject, the anomalous characters stated to belong to the supposed genus *Villiersia* entirely vanish, and the animal on which it was founded falls naturally into its place among the Dorides.

*Doris depressa* is generally found adhering to a species of *Lepralia*, incrusting the under side of stones in pools, near low-water mark, and so nearly resembles the zoophyte in colour as not to be detected without a close inspection. This circumstance, with the minute size and extreme flatness of the animal, may account for its having been so seldom observed, though the distant localities in which we have found it,—Northumberland and Devonshire,—show a tolerably wide range of distribution. It must still, however, be considered a rare species. It is of very sluggish habits, moving seldom and very slowly when in confinement. We have taken the spawn in September: it is deposited in a slender, depressed thread, arranged in a delicate, close, and regular spiral coil of nine or ten volutions; the ova are placed two or three abreast, and are of a delicate salmon-colour, not much differing from that of the *Lepralia*, on which it and the Dorides are usually found.

Figs. 1, 2. *Doris depressa*, different views.

3. A portion of the cloak, showing the tubercles.
4. A tentacle.
5. A branchial plume.
6. Spicula.
7. Spawn.
8. A portion of the same, showing the ova.

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\* Montagu describes "two pink oval vesicles" among the branchial papillæ on the back of his *Doris cærulea*, which are evidently the ovaries of this little parasite; and we have ourselves been occasionally deceived by their occurrence on other species, before we were acquainted with their true character.

## Fam. 1, Plate 12.

*Figs. 9 to 16.*

### DORIS INCONSPICUA, ALDER and HANCOCK.

*D. elliptica*, depressa; pallio purpurescenti-albido, punctis minutis fuscis, tuberculisque parvis, obtusis, ornato; tentaculis subrobustis, lamellis compactis; branchiis 10 obtusis, albidis, pinnatis, anum haud propinque cingentibus.

*Hab.* On *Cellepora pumicosa*, from the deep-water fishing boats, Northumberland, *Mr. R. Howse*.

*Body* nearly half an inch long, elliptical, depressed, and nearly equally rounded at both ends. *Cloak* of a dull white, tinged with purple, and sprinkled with very minute brown spots: it is covered with numerous small, obtuse, spiculate tubercles, nearly equal in size. The spicula of the cloak are rather small and stout; they are more regularly arched than usual, and are not arranged so regularly as in some of the allied species. *Dorsal tentacles* rather large, stout, and nearly linear; the upper portion is pale yellow, with about fourteen compact laminae, approaching very near to the apex and extending two thirds downwards. The margins of the cavities are plain, or with only the usual tubercles of the cloak. *Branchial plumes* ten, rather small and obtuse, dull white, set in an incomplete circle round the anus, and at a little distance from it. They are simply pinnate; the pinnæ being ten in number, rather stout and close-set. *Head* with a broad veil a little undulated at the margin. *Foot* elliptic-oblong, slightly bilobed in front, rounded behind, and extending a very little beyond the cloak when the animal is in motion. The colour is a dull white, with a slight tinge of yellow in front; the liver appears in a large, broad patch of dark purple through the centre.

This species is closely related to *D. pusilla* and *D. sparsa*, but may be readily distinguished from both by the form of the tentacles and branchial plumes, and from the former, especially, by the character of the tubercles.

Two individuals were obtained in March, 1848, adhering to *Cellepora pumicosa*, to which were also attached two patches of spawn. This is a close, depressed, spiral coil, with the eggs small, white, and rather numerous.

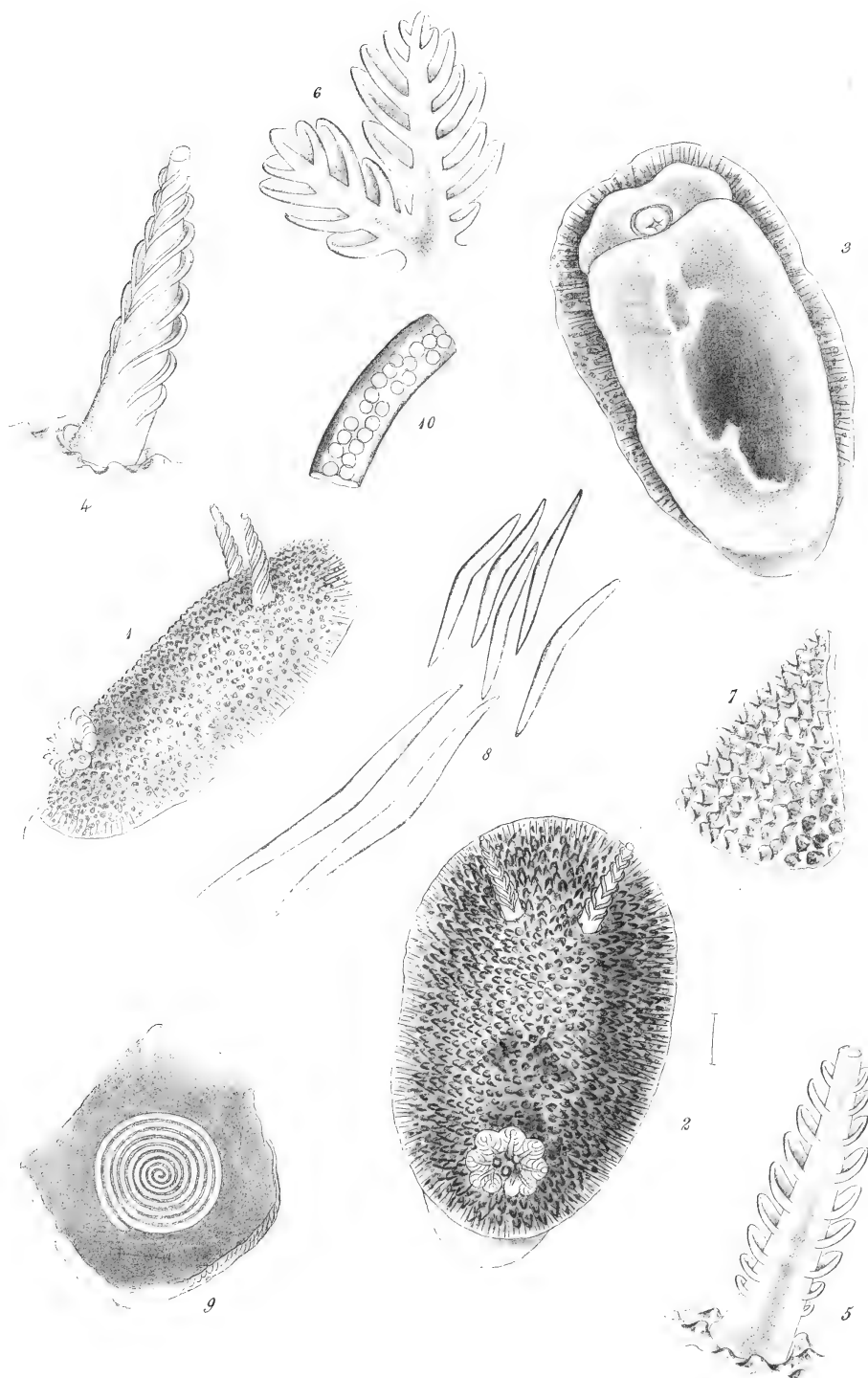
Figs. 9, 10. *Doris inconspicua*, different views.

11. A portion of the skin.
12. Tentacles.
13. A branchial plume.
14. Spicula.
15. Spawn.
16. A portion of the same, showing the ova.









A Hancock del

C. Hullmandel's Patent Lithogr.

DORIS PUSILLA.

## Fam. 1, Plate 13.

### DORIS PUSILLA, ALDER and HANCOCK.

*D. sub-ovata*, depressa; pallio lutescenti, maculis brunneis confertis; tuberculis conicis: tentaculis niveis gracilibus: branchiis 9, pinnatis, niveis, anum haud propinque cingentibus.

*Doris pusilla*, Ald. and Hanc. in Ann. Nat. Hist. v. 16, p. 313.

*Hab.* Under stones at low-water mark, Torquay.

*Body* about three lines long and nearly two broad, slightly ovate, much depressed. *Cloak* of a pale yellowish colour, closely freckled with dark brown, and covered with short, conical, bluntly-pointed tubercles, which are not spiculose: large spicula lie imbedded transversely across the back and diagonally at the sides, but in consequence of the dark markings they are not very conspicuous through the skin, excepting towards the margins. *Tentacles* pure white, rather long and slender, slightly tapering at the top and truncated. They have about nine laminae, and are without sheaths. *Branchial plumes* nine, short, stout, and simply pinnate, rather obtuse at the top, of a beautiful snowy whiteness, set in a small circle, interrupted behind, and leaving a tuberculated space within. The two posterior plumes appear to arise from those next them. *Head* with a broad veil, expanded and slightly bilobed. *Foot* almost colourless, having a tinge of yellow, rather sinuated in front, and extending a little beyond the cloak behind when the animal is moving: the liver appears distinctly through it, of a chocolate brown colour.

Of this interesting and pretty little species, two individuals were found among the rocks at the Gentlemen's Cove, Torquay, during a low spring tide. From its diminutive size and flattened form it had nearly been passed over as a small *Planaria*, but a second glance showed its true character. It comes very near to *Doris depressa*, but may readily be distinguished from that species by its darker colour, and the beautiful snow-white tentacles and branchial plumes: the latter are rather larger than in *D. depressa*, and form a smaller circle round the vent. The papillae of the cloak, too, are much shorter and stouter than in that species. The spawn of the two species is very similar, and unlike that of the other *Dorides*, forms a very thin spiral thread of many volutions, which might easily be mistaken for the spawn of an *Eolis*. In *D. pusilla* the number of volutions is nine, very closely set, and having only two or three ova in breadth throughout. It is deposited about the latter end of May.

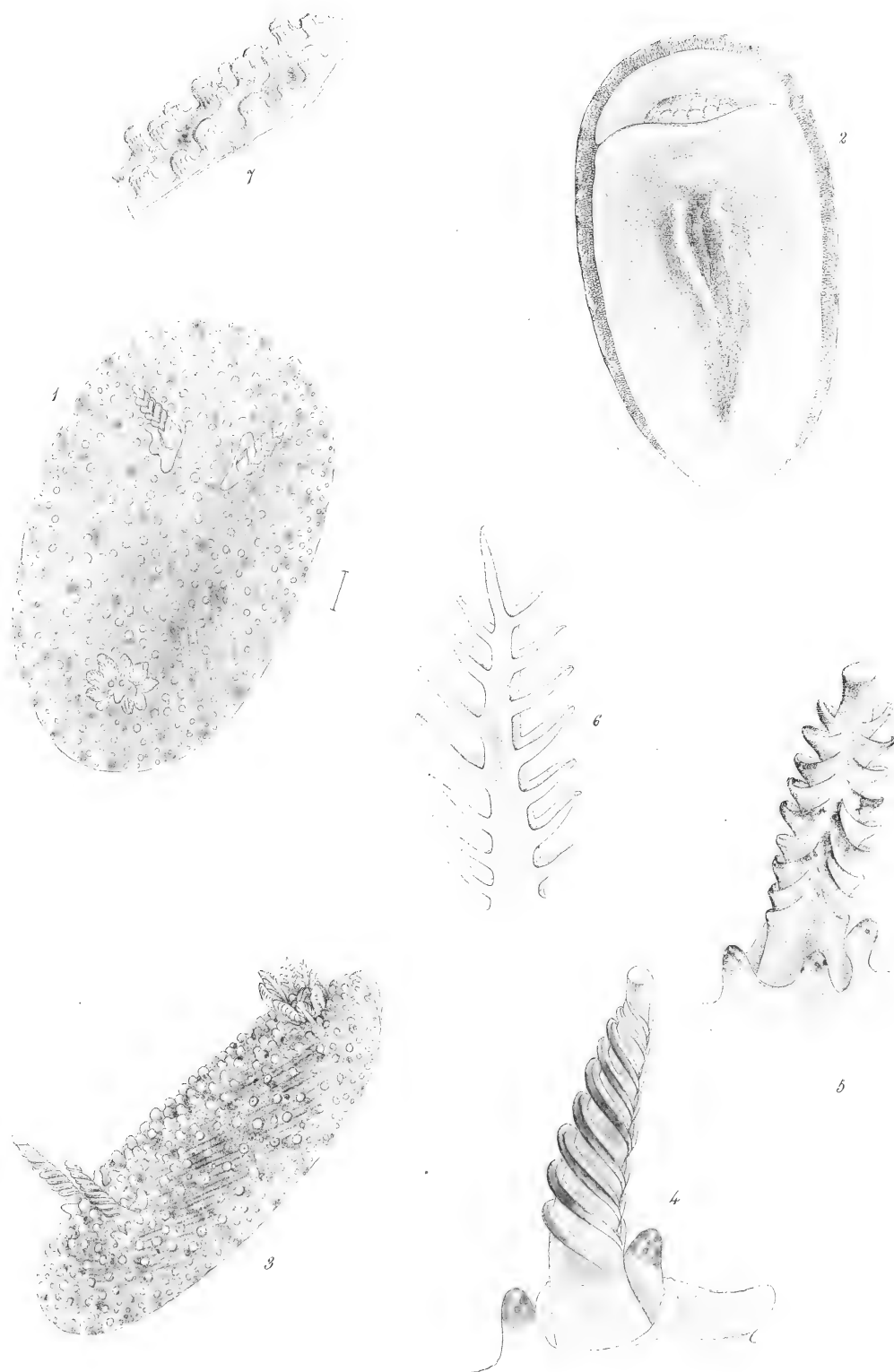
The spicula are smooth, rather bent in the centre, and tapering to a point at each end. The diagonal ones at the sides are very large, in proportion to the size of the animal.

Fig. 1, 2, 3. *Doris pusilla* in different positions.

4. A tentacle in profile.
5. The same, front view.
6. Branchial plumes.
7. A portion of the cloak.
8. Spicula.
9. Spawn.
10. A portion of the same more highly magnified.







Lancaster del. H. Holmes lithogr.

C. Culmann's Patent

## Fam. 1, Plate 14.

### DORIS SPARSA, ALDER and HANCOCK.

*D. depressa*: pallio lutescenti-albo, maculis paucis castaneis sparso, tuberculis remotis rotundatis: tentaculis subconicis, albis, brunneo lituratis, marginibus foraminum 3-4 tuberculatis: branchiis 9, parvis, pinnatis, anum haud propinque cingentibus.

*Doris sparsa*, Ald. and Hanc. in Ann. Nat. Hist. v, 18, p. 293.

*Hab.* On *Cellepora pumicosa* from the fishing boats, Cullercoats, A. H.

*Body* a quarter of an inch long, ovate, much depressed, and nearly equally rounded at both ends. *Cloak* extending very little beyond the foot, of an obscure pale yellow, with a few distant reddish-brown freckles or spots, and covered with smallish, obtuse, flattened, spiculose tubercles, set rather apart, and of unequal sizes, becoming smaller towards the margin. The cloak is stiffened and crowded with spicula, arranged transversely on the back, and diagonally at the sides: the margin beneath has a minutely scaled or reticulated appearance, probably caused by the ends of the spicula appearing through. *Dorsal tentacles* slightly conical, with eight or nine broad distant laminæ; whitish, or nearly colourless, with a few blotches of olive brown. They are without sheaths, but the margins of the cavities are furnished with three or four large tubercular points, and a small, smooth, whitish area extends into an obtuse point behind them. *Branchial plumes* nine, very small, simply pinnate, pointed, colourless; arranged in an incomplete circle, round the vent, leaving a small tuberculated space within. *Head* with a broad, laterally expanded veil, forming a semicircle parallel to the margin of the cloak. Mouth circular, with puckered lips. *Foot* ovate, truncated, and slightly sinuated in front, nearly as broad as the cloak, and occasionally extending a little beyond it posteriorly. It is pellucid and nearly colourless, with the liver appearing through the centre, rather narrower than usual, of a brownish salmon colour.

This species, though closely resembling *D. depressa* and *D. pusilla*, is readily distinguished from either by the character of the tubercles. From the former it also differs in the greater size of the branchiæ, and from the latter in their colour and form, as well as in the colour of the tentacles.

A specimen of this new *Doris* was obtained from the fishermen's lines at Cullercoats, in December, 1845. It was adhering to *Cellepora pumicosa* incrusting the base of a *Flustra*.

It lived with us more than a month, but did not show much activity, and seldom floated on the surface of the water.

Figs. 1, 2, 3. *Doris sparsa*, different views.

4, 5. Side and front views of a tentacle.

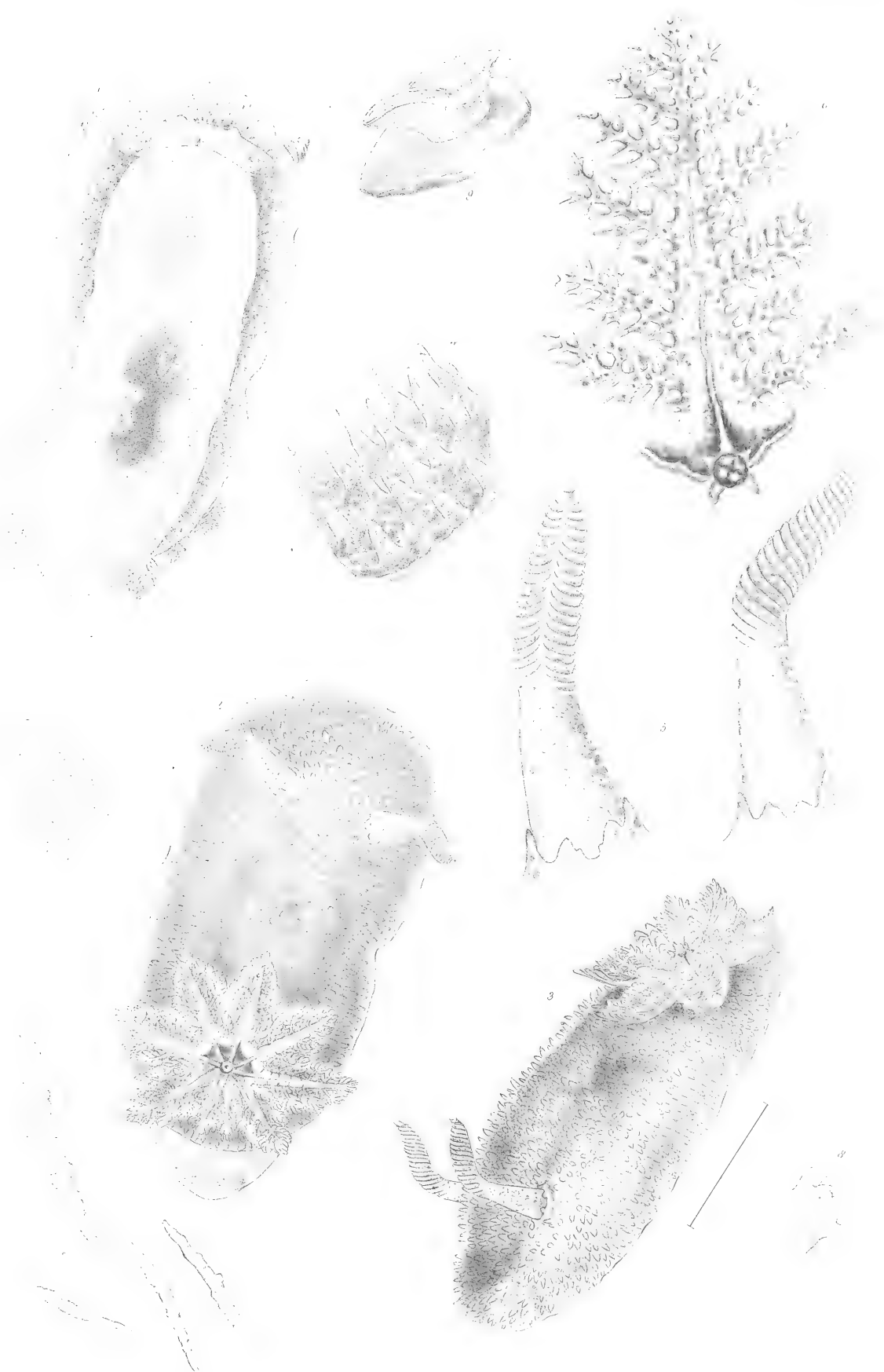
6. A branchial plume.

7. A portion of the cloak showing the tubercles.









2 Hancock del. W. Wing. lit.

C. Hullmandel's Parent lithom.

*DORIS PILOSA.*

## Fam. 1, Plate 15.

### DORIS PILOSA, MÜLLER.

*D. convexa*, subpellucida, lutea, alba, vel fusca; pallio papillis gracilibus oblecto; tentaculis longis, subcurvatis, vaginis parvis denticulatis; branchiis 7—9, magnis, effusis, tripinnatis, non retractilibus, astrum medio simulantibus.

*Het Eegeltje of de Zeeslak met eene ster op de stuit*, Bommé, in Act. Vlessing., v. 3, p. 298, f. 4.

*Doris pilosa*, Müll., Zool. Dan., v. 3, p. 7, pl. 85, f. 5—8.

Gmel., Syst. Nat., v. i, p. 3106.

Cuv., in Ann. du Mus., v. 4, p. 470.

Lam., Anim. sans Vert., 2d ed., v. 7, p. 464.

Johns., in Ann. Nat. Hist., v. 1, p. 54, pl. 2, f. 9, 10.

Thomp., in Ann. Nat. Hist., v. 5, p. 86.

*stellata*, Gmel., Syst. Nat., v. 1, p. 3107.

Cuv., in Ann. du Mus., v. 4, p. 470.

*nigricans*, Flem., in Edin. Encyc., v. 14, p. 618. Brit. Anim., p. 283.

Johns., in Ann. Nat. Hist., v. 1, p. 55.

*Flemingii*, Forbes, Mal. Mon., p. 3, pl. 1, f. 2, 3.

*sublævis*, Thomp., in Ann. Nat. Hist., v. 5, p. 87, pl. 2, f. 1.

*similis*, Ald. and Hanc., in Ann. Nat. Hist., v. 9, p. 32.

*fusca*, Lov., Ind. Moll. Scand., p. 4.

*Hab.* In shallowish water and within tide-marks, common.

*Body* varying in size from half an inch to nearly an inch and a quarter, ovate, very convex, and semitransparent. The colour is very various, ranging from pure white to yellowish white, canary yellow, yellowish brown, gray (produced by a freckling of the surface), purple-brown, and black. *Cloak* not extending much beyond the foot, containing few spicula, and covered with soft, slender, conical, pointed papillæ, which give it a pilose or tomentose appearance. The underside of the cloak is veined with white, and, in the coloured varieties, usually spotted. *Dorsal tentacles* long, linear, rather tapering, and bent slightly backwards for about half their length: the upper part is yellowish, with nineteen or twenty delicate laminae; the under part smooth, colourless, and transparent. The tentacles issue from very short, close, denticulated sheaths. *Branchial plumes* from seven to nine, large and spreading, united at the base, but not retractile within a cavity: they are imperfectly tripinnate, and have a rather broad midrib, on each side of which there is usually a broad, opaque white, internal, nodulous line, extending about two thirds up the plume, and diverging at the base, so as to form a star round the vent: this latter organ is also surrounded by small, pointed tubercles. The plumes are very transparent, and nearly colourless, but vary in this respect;

## DORIS PILOSA.

generally partaking, more or less, of the colour of the body: they are occasionally freckled with brown. *Head* surrounded by a short veil, produced at the sides into broad, flat oral tentacles, rounded at the ends, and a little angulated in front: they vary in shape according to the degree of expansion, and have usually a leaf-like appearance. *Foot* oblong, rounded at both ends, and extending a little beyond the cloak when the animal is crawling. It is of the same colour as the body, though usually rather paler, and, from its transparency, shows the liver, forming a brown patch near the centre. The spicula are rather small and nodulous, in this respect resembling those of a *Goniodoris*, to which genus, in some of its characters, this species approximates.

The Protean character of this common species makes it difficult to assign the limits of its variation, and consequently several species have been constituted out of it; we are now, however, inclined to consider all those we have given in our list of synonyms to be varieties of the same. We were for some time unable to ascertain the species of Bommé on which the *Doris stellata* of Gmelin was founded, having in vain attempted to find a copy of the work in which it is described in the libraries of this country. Through the kindness of a friend, however, we have been put in possession of a translation of Bommé's papers, with tracings of the plates. From these we are enabled to state, that his species is certainly our *Doris pilosa*. The description and figures are excellent, making a little allowance in the latter for the period when they were published. "The back," he says, "is elevated in the form of an egg, and rounded behind; the upper part of the body is as if covered with fur, . . . . this covering (cloak) is very rough, and clothed throughout with soft points." The pointed nature of the papillæ is also represented in the figures. Gmelin has, notwithstanding, rendered the character by these words, "supra tuberculis obtusis aspersa:" and Cuvier and Lamarck have each called the tubercles "rounded;" the former, perhaps, deceived by the contraction of spirit specimens. We do not wonder, therefore, to find succeeding authors at a loss about this *Doris*, or that Philippi should describe a species as *Doris stellata*, with the branchiæ retractile within a cavity. The branchial plumes of this species are contractile only, as is well described by Bommé:—"The most beautiful part of this little animal is the flower-like star on the rump. . . . This star is very sensitive; at the slightest touch the animal draws it as firmly as possible together:"—words perfectly describing the action, as we have frequently observed it. There is no branchial cavity in this species. The *Doris pilosa* of Müller is not quite so easily recognised, the description and figures being much inferior to Bommé's; but as succeeding authors have generally agreed in referring it to the species now under consideration, and the description, as far as it goes, is sufficiently appropriate, we have thought it best to retain the name. Professor Lovén, however, considers our species to be the *D. fusca* of Müller, the figure of which, in 'Zoologia Danica,' he states to have been inserted by mistake. That the *D. fusca* of Lovén's 'Index' is the same as ours, we are enabled to state from the examination of specimens obligingly sent to us by the author. *Doris sublævis* of Thompson we refer to this species, with some slight doubts. In this case, also, we have been kindly favoured with an examination of the specimen described. In all its characters it agrees perfectly with *Doris pilosa*, excepting that the cloak appears nearly smooth, a circumstance we are inclined to attribute to its state of preservation; we have seen living examples of the large variety, with the papillæ less conspicuous than in others. As to our own *Doris similis*, the principal peculiarity of which is the want of the white star in the branchiæ, we think it safest at

## DORIS PILOSA.

present to merge it also among the varieties of this difficult species, leaving it to time to show if any permanent difference can be substantiated. *Doris rocinela* and *D. ochracea*, of Leach, specimens of which are preserved in the British Museum, appear to be varieties of *D. pilosa*.

The breeding season of this species commences in April, but the spawn is not abundant until May or June, and patches may occasionally be found as late as September; it is of a pretty cup-like form, with the margin turned outwards, and in some cases a little flounced. The ova, which are small and whitish, are very numerous, and arranged in distinct transverse lines.

*Doris pilosa* inhabits the littoral and laminarian zones, and is often found further above low-water mark than most of its congeners. It is comparatively active, and is with difficulty kept alive in confinement, from its propensity to crawl out of the water. Its range, as far as we at present know, is confined to the Atlantic shores of Europe.

The heart pulsates about sixty-eight times in a minute.

Figs. 1, 2, 3. *Doris pilosa*, different views.

4. A portion of the cloak, highly magnified.
5. Dorsal tentacles.
6. A branchial plume.
7. Spicula.
8. Anal nipple.
9. Spawn.
10. A portion of the same, showing the ova.







J Alder del. W. Ming Zuccanti

Pl. 100. 100. 100. 100.

Figs. 1, 2, 3. DORIS SUBQUADRATA. Figs. 4, 5. DORIS OBLONGA.



## Fam. 1, Plate 16.

*Figs. 1, 2, 3.*

### DORIS SUBQUADRATA, ALDER and HANCOCK.

*D. crassa*, alba, subpellucida; pallio parvo, subquadrato, caput et pedem haud tegente, papillis parvis; tentaculis crassis, vaginis lævibus; branchiis 7, magnis, bipinnatis, repandis, non retractilibus; pede crasso.

*Doris subquadrata*, Ald. and Hanc., in Ann. Nat. Hist., v. 16, p. 313.

*Hab.* In deepish water, Torbay, J. A.

*Body* nearly an inch long, rather elevated, white, with a slight yellowish tinge, semi-transparent. *Cloak* small, scarcely covering the head when the animal is extended, and exposing the foot behind. It is somewhat squared before and behind, and has the edge mostly a little elevated; it is not very convex, and is thinly covered with smallish, unequal conical papillæ, which become larger towards the sides. *Dorsal tentacles* stout and subclavate, with twelve or fourteen laminae scarcely reaching behind. They issue from very short sheaths with smooth edges. *Branchial plumes* seven, non-retractile, bipinnate; the anterior and lateral ones large and spreading; the posterior small, with an additional branch on the inside. The plumes have each a very strong midrib, which is attached for nearly half its length to the cloak, leaving only the ends and sides of the plumes free. These ribs expand very much at the base, and become confluent with the central area surrounding the anus. The plumes are of a transparent yellowish white, and have an opaque white line on each side of the midrib, as in *Doris pilosa*, but less conspicuous: the whole forms an irregular star longest in the transverse diameter. *Head* furnished with a semicircular veil, produced into rounded obtuse angles at the sides. *Foot* very large and thick, rather rounded in front, and extending to a blunt point considerably beyond the cloak behind. The sides are high, and there is a slight ridge from the posterior part of the cloak to the tail.

We have met with only one example of this interesting *Doris*. It was dredged near Berry Head, Torbay, in May, 1845, and, unfortunately, did not live very long after its capture, so that its habits remain unobserved. From the softness of the cloak we conclude that it contained very few spicula, but we were unwilling to cut up our single specimen to ascertain their character.

This *Doris*, which is closely related to *D. pilosa*, forms, from the smallness of its cloak, a connecting link between this genus and *Goniodoris*.

## Fam. 1, Plate 16.

*Figs. 4, 5.*

### DORIS OBLONGA, ALDER and HANCOCK.

*D. oblonga*, convexa; pallio lutescente, fusco-maculato, tuberculis acutis, spiculis oblecto; tentaculis, subcrassis; branchiis 7, pinnatis, albidis, non retractilibus: capite velato.

*Doris oblonga*, Ald. and Hanc., in Ann. Nat. Hist., v. 16. p. 314.

*Hab.* In deepish water off Berry Head, Torbay, *J. A.*

*Body* about half an inch long, slender, oblong-ovate, tapering behind, rather convex in the middle of the back and flattish at the sides. *Cloak* pale straw-coloured, freckled and spotted with umbre-brown; densely spiculate, and covered with moderately-sized, conical, spiculate, pointed papillæ. *Dorsal tentacles* yellowish, without sheaths, rather thick, and very finely laminated, ending in an obtuse point. *Branchial plumes* about seven, pinnate, non-retractile, yellowish white, moderately long, and not much spreading. They are surrounded by a circle of large tubercles. *Head* furnished with a large semicircular veil. *Foot* rather narrow, nearly straight and slightly notched in the centre in front, tapering to an obtuse point, which does not extend beyond the cloak, behind.

We know of no other *Doris* with which this species can be readily confounded. It was obtained by dredging at the same time and place with the last, but was in a sickly state, and died soon after it was brought on shore.





A. Hancock, del. W. W. M. G. 1841.

Forl & West Imp.

## Fam. 1, Plate 17.

### GENUS 2. GONIODORIS,\* FORBES.

*Corpus* limaciforme, subangulatum, posticè acuminatum, pallio parvo marginibus reflexis pænè obtectum. *Caput* ultra pallium prominens, in tentacula 2 labialia complanata extensum. *Tentacula dorsalia* 2, laminata, non retractilia. *Branchiæ* plumosæ, non retractiles, postice in lineâ mediâ dorsi anum circumdantes. *Apertura genitalis* ad latus dextrum.

This genus has been very properly separated from *Doris* by Professor Edward Forbes, who described it in the 'Annals of Natural History,' for March 1840.† It is distinguished from *Doris* by the small cloak, the more angular body, and the tapering form of the posterior extremity. To these characters we have added the exposure of the head beyond the cloak in front, and the non-retractibility of the dorsal tentacles and branchial plumes.

The additional characters we consider necessary for the more accurate definition of the genus, though by thus restricting it, we exclude a beautiful group of the *Dorididæ*, with a small cloak, peculiar to warmer climates, and distinguished by the brilliancy of their colours, which are generally disposed in stripes, spots, or marginal bands. In this group, which it was the original intention of Professor Forbes to include in his genus, the cloak, though small and narrow, is advanced before the head, and the dorsal tentacles are retractile within cavities; the body also has a more bi-lamellar form. The group in question appears to us to constitute a well-marked genus, distinct from *Goniodoris*, from which we have consequently excluded it. *Goniodoris*, as now restricted, contains a very limited number of species, confined, so far as we at present know, to European seas. Herrmannsen erroneously states that the type of this genus is the *Doris gracilis* of Rapp, a Mediterranean species, of deep blue colour with white stripes, belonging to the southern group already mentioned. The true type of *Goniodoris* we take to be the *Doris nodosa* of Montagu, of which the *Goniodoris emarginata*, described by Professor Forbes in the paper where he characterises the genus, is a variety.

This genus has the body of a sub-quadrilateral form, with elevated sides and tapering posteriorly to a pointed tail. The cloak is small with a waved margin, generally reflected, and is truncated or sinuated posteriorly immediately behind the vent. A median ridge, sometimes not very distinctly marked, on the cloak, is continued conspicuously to the tail. The head extends beyond the cloak in front, and is covered by a subvelar expansion, which is produced into flattened oral tentacles at the sides. The mouth is inferior, without corneous jaws, but with a spinous prehensile collar, and a denticulated tongue. The dorsal tentacles are clavate and laminated, and are non-retractile. The branchiæ are plumose, and surround

\* From *γωνία*, an angle, and *Doris*.

† Vol. 5.

## GONIODORIS.

the vent on the median line about two thirds down the back. They, like the tentacles, are non-retractile and are without lateral appendages. The foot is rather large, rounded in front, and produced into a point behind. The generative organs have a single aperture, which is situated on the right side, a little behind the dorsal tentacles.

In its internal structure *Goniodoris* is not very dissimilar from *Doris*. The mouth opens on the inferior surface of the head, whence a short channel leads into the buccal organ (Pl. 17, fig. 1 *a*), which, though not very large, is muscular, and has appended to its upper surface a spherical gizzard (*b*), with radiating muscles, similar to that in *Doris bilamellata* and others. The tongue is narrow, and composed of numerous rows of four plates each; the two plates next the median line bearing large curved spines with denticulated margins in *G. nodosa*: in *G. castanea* the margins are plain. There is no central spine or plate. Not more than half of the tongue is brought into action at a time, the posterior portion being tubular and placed in a sheath which extends from behind the buccal organ: here the spines are generated, as in *Doris*. The buccal lip is provided with a prehensile collar (fig. 2 *a*), interrupted above, and crowded with numerous, minute, bifid spines (fig. 3).

The œsophagus (fig. 1 *d*), which is rather long and slender, passes from the upper aspect of the buccal organ just behind the gizzard, and, after passing through the nervous collar, is slightly dilated in *G. nodosa*, but in *G. castanea* is of equal caliber throughout. Two short, folliculated salivary glands (*c, c*) open into the buccal cavity, one on each side of the œsophagus. The stomach (*e*) is small, of an irregular form, situated in a shallow cleft in the anterior border of the liver. The œsophagus enters it in front, and the intestine (*g*), which is a simple tube of no great diameter, passes off from the upper aspect, and crossing the upper surface of the liver, dips down on the right side on its way to the anal nipple, situated in the centre of the branchial circle. The biliary secretion enters the digestive cavity by two or three large orifices near to the œsophageal opening. No pancreatic organ has been observed. The liver (*f*) is a large oval mass, filling up the posterior portion of the visceral cavity, and having a shallow cleft in front for the reception of the stomach; it is granular and of the usual dark brown colour.

The reproductive organs are constructed on the same plan as in *Doris*, but show some interesting modifications of the component parts. The testis is divided into three well-marked portions;—next the intromittent organ (*h*), it is stout and tubular (*i*); some distance backwards it suddenly contracts and becomes minute and duct-like (*i'*); this second portion leads to one extremity of a fusiform, glandular body (*i''*), which is doubled upon itself, and has the other extremity opening into the oviduct. The second portion seems deficient in *G. castanea*. The gland-like portion of the testis has some similarity to that described in *Doris coccinea*. The ovary (*k, k*) is spread over the upper surface of the liver, and presents a decidedly dendritic structure, crowded exteriorly with numerous ovigerous follicles. The oviduct is at first very slender (*j*), but, suddenly dilating, becomes excessively wide, and as it advances to the anterior margin of the mucus-gland it is reduced at once to its original caliber before receiving the extremity of the testis; it shortly afterwards receives the duct (*o*) from the spermathecæ and thence dips down into the mucus-gland. The vaginal tube (*m*), is rather wide and long; it is doubled upon itself, and before reaching the spermatheca is much attenuated. There are two spermathecæ, one very large (*n*), the other small (*p*), the former is long and pyriform, the latter elliptical. The mucus-gland (*l*) does not differ materially from

## GONIODORIS.

that of *Doris*. In *G. castanea* the vaginal tube is very much shorter than in *G. nodosa*, and can scarcely be said to be doubled upon itself; the large spermatheca is elliptical, and is also much smaller than in the other species.

The vascular and respiratory system, so far as we have been able to ascertain, are in the same condition as in *Doris*. The heart rests on the upper surface of the liver, and is contained in a well-defined pericardium (*q*). The auricle (*s*), receives the blood by two lateral vessels (*t, t*), from the skin, and by a posterior median one (*u*), from the gills; that is, in this way it is returned from the general system and from the liver mass: it is then passed into the ventricle (*r*), and is distributed to the various organs by arteries, which branch from a large trunk that issues, in the usual manner, from the anterior apex of the propelling organ. The portal heart (*w*), is distinctly seen lying below the pericardium, into which it opens, and its vascular trunk can be traced into the renal organ. From these facts, it is evident that here, as in *Doris*, the blood is returned to the heart only partially aerated, and that the systemic circulation is twofold,—general and partial; the latter comprising a portal circulation.

The renal organ (*y*) covers the greater portion of the upper surface of the liver, lying immediately above the ovary, and resembles the same organ in *Doris pilosa*. Its margins are somewhat sinuous, and the inner surface of the circumscribing membrane is richly supplied with a vascular net-work, with which the twigs from the trunk given off by the portal heart go to inosculate. The renal orifice opens externally, close to the base of the anal nipple, in front and to the right side.

The nervous system is highly concentrated in this genus. There are four principal œsophageal ganglia, and four buccal; of the former, two are above, and two at the side of the alimentary tube; those above are broadly ovate, with their sharper ends placed towards the median line, across which they are united. These ganglionic masses (fig. 4 *a, a*) are composed of the cerebroid and branchial ganglia, completely fused; and give off, from the upper surface of the frontal margin two large nerves (1), which go to the dorsal tentacles: these have attached to them, at their origin, the olfactory ganglia (*c, c*), which are round, and almost as large as the buccal ganglia. Three other pairs of nerves (2, 3, 4) pass from the under surface in front, and go to the channel of the mouth and lips; the largest of these (3) gives a stout branch to the oral tentacles. From behind,—the branchial portion,—a larger nerve (6) is given off from each mass, and goes to supply the dorsal skin or mantle.

The pedial or lateral ganglia (6, 6) are closely united to the under surface of the upper pair, and are joined below the œsophagus by a short, stout, commissural cord (*g*), the great œsophageal collar, composed of two filaments—one being much finer than the other. These ganglia furnish each two or three nerves to the foot.

A small visceral ganglion (*d*) is attached to the under surface of the right upper ganglionic mass behind; consequently to the branchial portion of it. It gives off two or three nerves (11, 12), which go to the viscera. A commissural cord (*i*), also comes off from this ganglion, and passing under the alimentary tube, in conjunction with the great œsophageal or pedial collar, goes to the branchial portion of the opposite ganglion. There is also another nerve from the œsophageal ganglia; this (7) comes from the right upper ganglion, close to the visceral, and may possibly belong to it. This nerve goes to one or two small ganglia (*j*), on the root of the penis.

The eyes, which are as well developed as in *Doris*, are fixed on small roundish ganglia

## GONIODORIS.

(5), which are sessile on the outer margin above, of the cerebroid portion of the upper ganglia. The auditory capsules contain numerous otoliths, and are seated upon the under surface of the upper ganglia, near to their junction with the pedial.

The buccal ganglia (*e, e*) occupy their usual position on the buccal mass, immediately behind the œsophagus: they are elliptical, are united across the median line by a longer commissure than usual, and are joined to the upper ganglia by two fine cords (*h, h*). These ganglia give nerves to the tongue (15), and buccal organ (13, 14), and have attached to them by longish pedicles a pair of gastro-œsophageal ganglia, (*f, f*), which send two nerves (16) down the œsophagus, and also supply the salivary glands.

The only traces that we have detected of a sympathetic system are the œsophageal nerves, and the small ganglia, and some minute nerves on the root of the intromittent organ.

The skin is soft and more or less tuberculated; and though well supplied with spicula, they are not sufficiently numerous to stiffen the surface.

## EXPLANATION OF THE PLATE.

- Fig. 1. General view of the viscera of *Goniodoris nodosa*, partially spread out and seen from above:—*a*, buccal mass; *b*, buccal gizzard; *c, c*, salivary glands; *d*, œsophagus; *e*, upper portion of stomach; *f*, liver mass; *g, g*, intestine; *h*, retracted penis; *i*, tubular portion of testis; *i'*, glandular portion of the same; *i''*, small tubular or duct-like portion of the same; *j*, portion of oviduct as it leaves the ovary; *j'*, dilated portion of the same; *k, k*, ovary overlying the liver; *l*, mucus-gland of female organs; *m*, vaginal tube, leading from the exterior to the spermatheca; *n*, spermatheca; *o*, tube leading from the same to the oviduct; *p*, accessory spermatheca; *q*, pericardium; *r*, ventricle, seen through the transparent walls of the pericardium; *s*, auricle; *t, t*, lateral trunk-veins from mantle to auricle; *u*, branchio-cardiac vein; *w*, portal heart, seen through the transparent membranes of the heart; *x*, branchial plumes; *y*, renal organ; *z*, cerebral ganglions.
2. Front view of the prehensile collar of *Goniodoris nodosa*:—*a*, collar; *b*, membranous fringe attached to the inner margin of the same; *c*, buccal lip; *d*, buccal orifice.
  3. A few of the spines from the prehensile collar of *Goniodoris nodosa*.
  4. Cerebral ganglions of *Goniodoris nodosa*:—*a, a*, cerebroid and branchial ganglions fused into two masses; *b, b*, pedial; *c, c*, olfactory; *d*, visceral; *e, e*, buccal; *f, f*, gastro-œsophageal; *g*, great œsophageal collar; *h, h*, nervous cords connecting the buccal ganglions to the cerebroids; *i*, small collar uniting the branchial and visceral ganglions; 1, olfactory nerves; 2, nerves supplying the upper portion of the channel of the mouth; 3, those to the side of the oral channel and oral tentacles; 4, those to the under side of the channel of the mouth; 5, eyes, each seated on a small ganglion; 6, pallial nerves; 7, a nerve which goes to a small ganglion (*j*) seated on the root of the male intromittent organ; 8, 9, 10, pedial nerves; 11, 12, visceral nerves; 13, 14, buccal nerves; 15, lingual nerves; 16, œsophageal nerves.
  5. Front view of the rudimentary prehensile collar of *Idalia pulchella*:—*a*, spinous lobes; *b*, buccal lip; *c*, oral opening.
  6. Two spines from the same highly magnified.
  7. Front view of prehensile collar of *Ancula cristata*:—*a*, upper margin.
  8. A few of the spines from the same much enlarged.

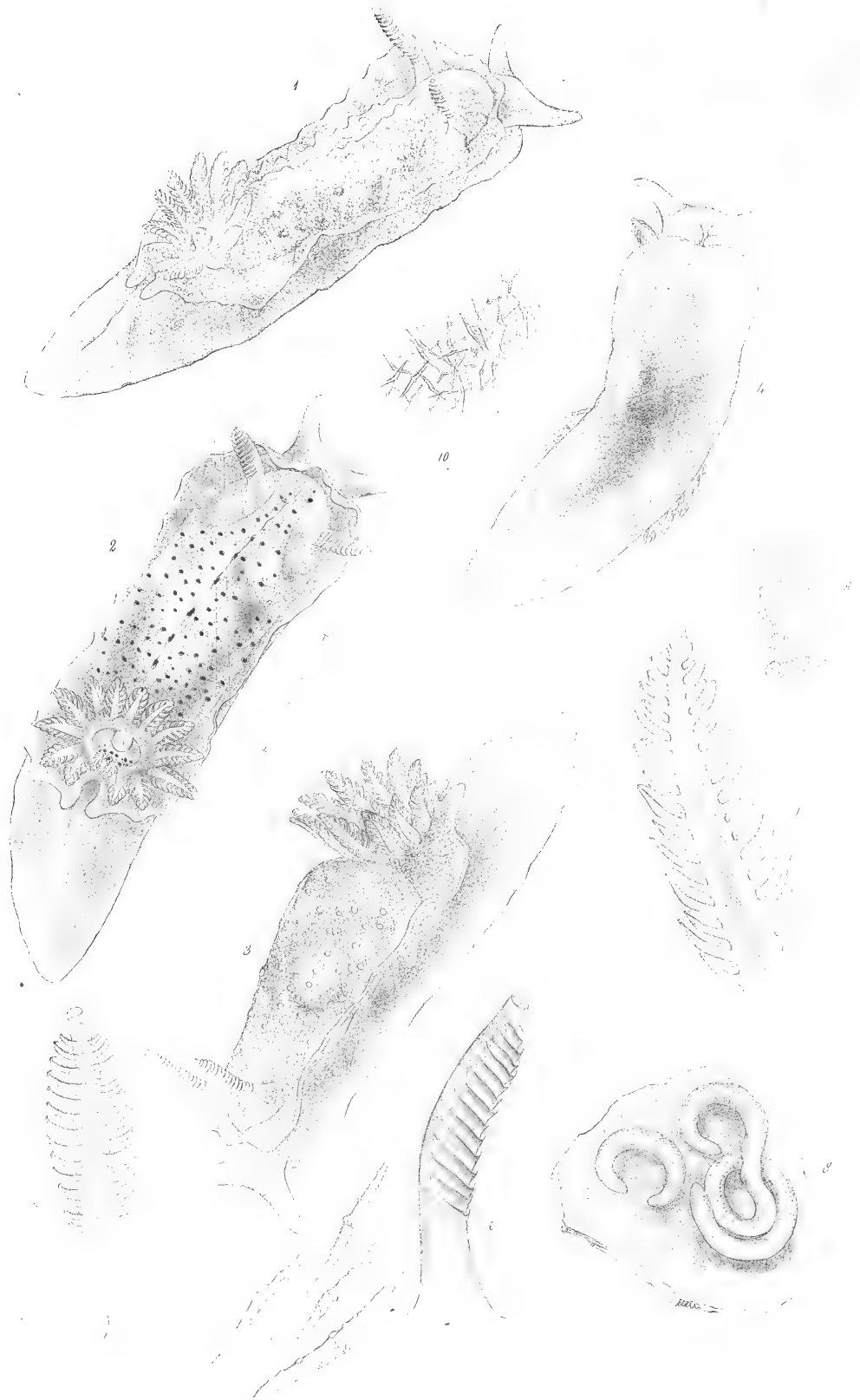


## GONIODORIS.

- Fig. 9. General view of the viscera of *Polycera quadrilineata*, the dorsal skin being laid open and the various organs a little separated:—*a*, buccal mass; *b*, salivary glands; *c*, œsophagus; *d*, upper wall of stomach; *e*, intestine; *f*, vent; *g*, liver mass enveloped in the ovary; *h*, retracted penis; *i*, glandular portion of testis; *i'*, tubular portion of the same; *i''*, constricted tubular portion; *i'''*, short tube uniting the glandular portion to the oviduct; *j*, oviduct as it leaves the ovary; *j'*, dilated portion of the same; *k*, mucus-gland in connexion with female parts; *l*, vaginal tube leading from the exterior of the spermatheca; *m*, spermatheca; *n*, tube from the same to the oviduct; *o*, accessory spermatheca; *p*, ventricle of the heart, turned forward; *q*, a portion of the auricle; *r*, arterial trunks; *s*, cerebral ganglia; *t*, branchial plumes.
10. External view of one of the jaws of *Polycera quadrilineata*:—*a*, cutting edge; *b*, upper margin.
  11. Jaws of *Polycera Lessonii*, as seen in the compressor of the microscope, the buccal mass laid open from below:—*a*, buccal lip; *b*, jaws; *c*, point of articulation; *d*, cutting edge.
  12. Cerebral ganglions of *Polycera quadrilineata*:—*a*, *a*, cerebroid ganglions; *b*, *b*, branchial; *c*, *c*, pedial; *d*, olfactory; *e*, visceral; *f*, buccal; *g*, *g*, commissural cords connecting the buccal ganglions to the cerebroids; *h*, small collar uniting the branchial and visceral ganglions; *i*, great œsophageal collar; 1, olfactory nerves terminating in ganglionic enlargements (*j*) within the tentacles; 2, nerves to the oral tentacles; 3 and 4, those to the channel of the mouth; 5, optic nerves, each having at its origin a small ganglion; 6, nerves supplying tentacular filaments and dorsal skin in front; 7, pallial nerves; 8, a nerve to the skin on the side of the body; 9, 10, 11, pedial nerves; 12, 13, buccal nerves; 14, lingual nerves; 15, œsophageal nerves; 16, 17, 18 visceral nerves.
  13. Buccal mass of *Ægirus punctilucens*, side view:—*a*, channel of the mouth; *b*, œsophagus; *c*, lingual sheath; *d*, *d*, salivary glands; *e*, glandular organ, supposed for secreting mucus to lubricate the foot.
  14. Front view of buccal mass of the same, the channel of the mouth having been removed:—*a*, buccal lip; *b*, oral opening; *c*, lingual sheath; *d*, upper corneous jaw, or tooth; *e*, lateral membranous fringes.
  15. Corneous jaw or tooth of *Ægirus punctilucens* removed from the buccal lip:—*a*, cutting edge with median denticle.







## Fam. 1, Plate 18.

### GONIODORIS NODOSA, MONTAGU, *sp.*

*G. alba*, vel flavescens, carneo-tincta, maculis albis opacis: pallio, margine inciso, medio carinato, tuberculis utrinque instructo; branchiis 13, pinnatis.

*Doris nodosa*, Mont. in Linn. Trans. v. 9, p. 107, pl. 7, f. 2. Flem. Brit. Anim. 282.

*Doris Barvicensis*, Johns. in Ann. Nat. Hist. v. 1, p. 55, pl. 2, f. 11—13. Thomp. in Ann. Nat. Hist. v. 5, p. 87.

*Goniodoris nodosa*, Forbes in Ann. Nat. Hist. v. 5, p. 105.

*Goniodoris emarginata*? Forbes in Ann. Nat. Hist. p. 105, pl. 2, f. 12.

*Goniodoris elongata*? Thomp. in Ann. Nat. Hist. p. 88, pl. 2, f. 17.

*Hab.* Under stones and in crevices of rocks within tide marks, and in shallow water; not uncommon. Coast of Devonshire, *Montagu*. Cornwall, *R. Q. Couch, Esq.*, Torbay. St. Andrews, *Rev. Dr. Fleming*. Berwick Bay, *Dr. Johnston*. Shetland and Isle of Man, *Professor E. Forbes*. Penmaen-rhos and Llandillo Bay, North Wales, *J. Price, Esq.* Lambay Island (*G. elongata*), Killery Bay, county Galway, and North of Ireland, *W. Thompson, Esq.* Courtmacsherry Bay, county Cork, *Professor Allman*. Dublin Bay and Malahide. Tynemouth, Cullercoats, and Whiteley.

*Body* about an inch long, ovate-oblong, sub-prismatic, rounded above, produced and obtusely-pointed behind, of a transparent white, tinged with rose- or flesh-colour, and sprinkled with very minute opaque white or yellow spots. *Cloak* subquadrangular, or somewhat fiddle-shaped, not much produced, rounded on the back, with a free margin which is scalloped into points, deeply notched behind, and generally turned upwards. It is sprinkled, especially towards the sides and at the posterior end, with very minute opaque white or sulphur-yellow spots; larger and more distant spots are disposed over the back. An elevated ridge, more or less distinct, runs down the centre, and two or more irregular rows of tubercular elevations down the sides of the back, each tipped with white. These are readily seen in young individuals, forming generally two indistinct rows: in full-grown specimens they are more numerous and less regular, and not always distinctly visible. *Dorsal tentacles* yellowish, strongly laminated on the upper portion, with about thirteen or fourteen plates, above which the shaft is produced and truncated; the lower portion for about one third the length is smooth. The parts of the cloak around the tentacles are slightly depressed, but appear more so from being very transparent, and without opaque spots. *Head* appearing beyond the cloak in front, having the sides produced into flat, angular, blunt, tentacular processes, occasionally tinged with yellow. *Branchial plumes* thirteen, large, pointed, transparent and colourless; thick in the central stem, and simply pinnate, with alternate larger and smaller laminae: they form a nearly complete circle round the vent, which is tubular. In large individuals there are three small additional plumes which fill up the posterior opening of the circle. Behind these there is a transparent spot, caused by a deep indenture of the cloak, which has been taken for a pore: there is, however, no perforation. The body is extended considerably behind the cloak into a blunt-

#### GONIODORIS NODOSA.

pointed tail, down the central ridge of which is a sulphur-yellow streak. *Foot* oblong, rounded in front and pointed behind, of a bright rosy brown in the centre from the liver appearing through.

Calcareous spicula are imbedded in almost every part of the skin of this animal, but nowhere crowded except in the oral tentacles and at the tail, where they form slightly radiating, dense tufts: a few pass transversely over the back and across the foot; they are more numerous in the margin of the cloak and along the sides, forming two longitudinal rows on each side, uniting at the tail. In the dorsal tentacles they are small and curiously bent to suit the cylindrical form of these organs, in which they are placed crosswise. The spicula of the body are rather large, crystalline, pointed at the ends and slightly bent in the middle, and are covered with distant irregular nodulous rings.

The pulsations of the heart are 72 in a minute.

This species appears to be common on all parts of our coast. It is liable to some variation, especially in the tubercles, which has given rise to several spurious species; at least such we are now inclined to consider them after a long and tolerably intimate acquaintance with the several varieties.

It may, however, be necessary to enter a little more into detail in justification of this opinion, in which we unfortunately differ from some of our brother naturalists. *Goniodoris nodosa* is to be found between tide-marks on the Northumberland coast nearly the whole year round, but is most plentiful in the months of April and May, at which time it is in the height of the spawning season. Large full-grown specimens may then be found in the crevices of the rocks and under large flat stones, congregated together in considerable numbers; so many as forty or fifty specimens have been found under the same stone. At this season the tints of colour are rather brighter than usual, particularly the blue patch on the right side, which is produced by that curious organ, called the purple bag by Swammerdam, appearing through the transparent skin. They are at this time generally distended with spawn, which stretches the skin so as to entirely obliterate the tubercular elevations on its surface. In this state we take it to be the *Doris Barvicensis* of Dr. Johnston. It is not uncommon, however, to find large specimens at this season with the tubercles large and conspicuous. At the commencement of the breeding season the tubercles are in all stages of development, from the most perfect down to entire obliteration, when their white apices alone mark their situation. After spawning most of the large individuals disappear, and the species is scarce on the coast for a while until the young animals begin to make their appearance, which they do in August. These are sometimes without tubercles in their earliest stage, and the skin so thin as to allow the liver to impart a pink or brownish colour to the back. This state exactly resembles the *G. emarginata* of Forbes. They soon assume the form of *Doris nodosa*, Mont., which they retain through the remainder of the season, though they continue to grow for some months afterwards. We have some suspicion that the *Doris marginata* of Montagu may be another variety of this species, but if so the figure is incorrect, as the foot is not seen beyond the cloak. *Goniodoris elongata*, Thomp., we also place, not without hesitation, as another variety: one reason for doing so is, that we collected many specimens of *G. nodosa* at Malahide (a locality near to that where *G. elongata* was obtained,) which assumed, especially when contracted in spirits, much of the elongated form of the latter animal.

## GONIODORIS NODOSA.

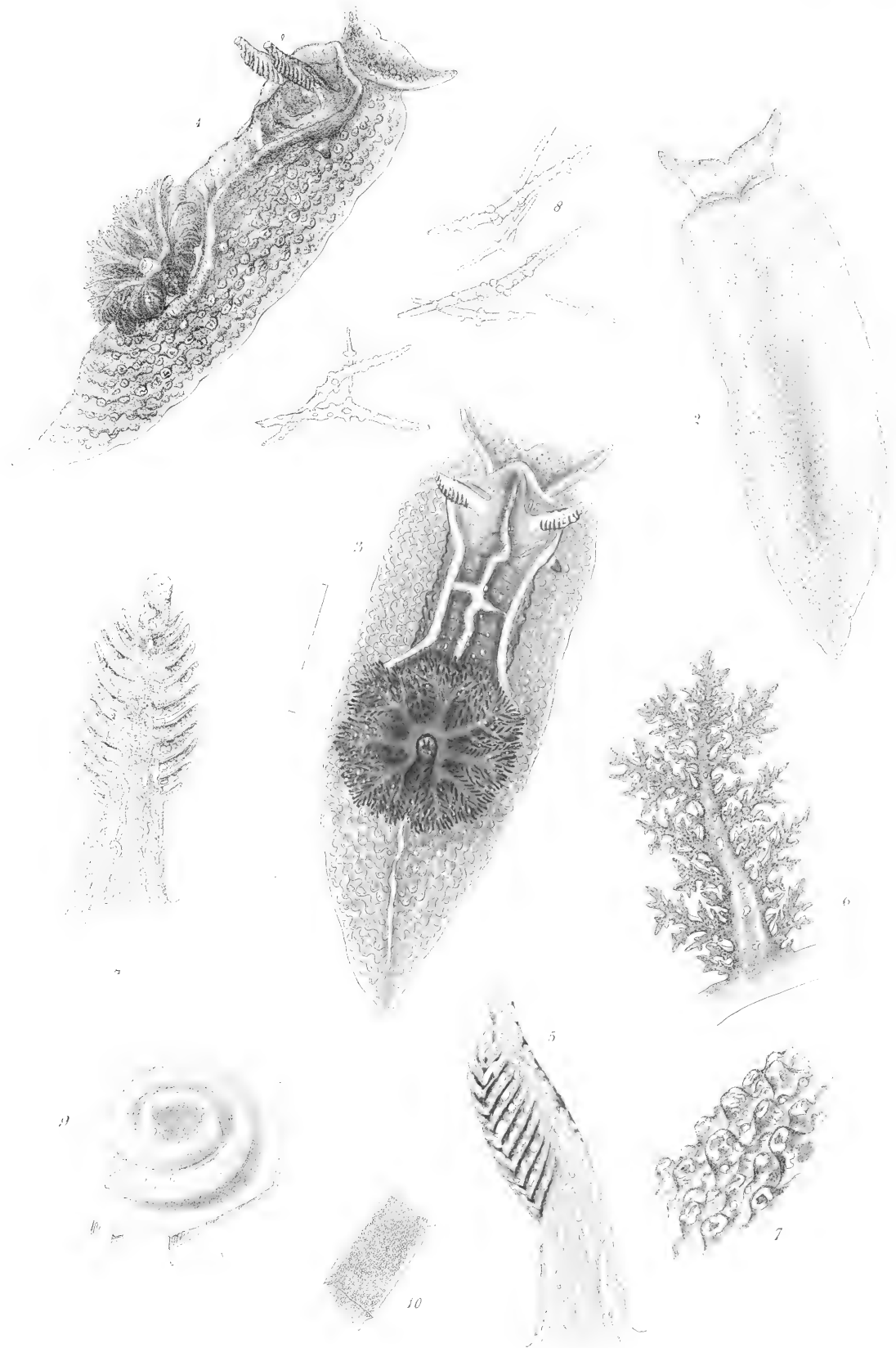
The spawn forms a thick narrow belt, curved into an imperfect circle, and is generally of a rosy hue. The eggs are small and numerous, nearly filling the gelatinous envelope. Sometimes the coil takes a second irregular turn, having the appearance of two masses united, as represented in the drawing.

- Fig. 1. *Goniodoris nodosa*, tuberculated state.  
2, 3, 4. Different views of the same with the tubercles obliterated.  
5, 6. Dorsal tentacles.  
7. A branchial plume highly magnified.  
8. Spawn.  
9. A portion of the same more highly magnified.  
10. A portion of the skin with imbedded spicula.  
11. A few of the spicula more highly magnified.









## Fam. 1, Plate 19.

### GONIODORIS CASTANEA, ALDER and HANCOCK.

*G. ovata*, castanea vel brunnea, albo maculata, tuberculis undique instructa: pallio parvo, margine undato, medio carinato: tentaculis labialibus latis, apicibus acuminatis: capite medio sinuato.

*Goniodoris castanea*, Ald. and Hanc. in Ann. Nat. Hist. v. 16, p. 314.

*Hab.* Under stones near low-water mark. Salcombe Estuary, Devonshire, *J. A. Saltcoats*, Ayrshire, *Mr. D. Landsborough, jun.*

*Body* three quarters of an inch long, ovate, rather broad and flattish, generally of a reddish brown colour, but sometimes of a very dark brown, and rarely of a pale grayish brown approaching to white; covered with soft warty tubercles, which are conical with flattened apices, and conspicuously blotched and spotted with opake white. *Head* warty, bilobed, deeply sinuated in the centre, arched and terminating in tentacular points at the sides; a ridge runs up each side from these points to the margin of the cloak. *Cloak* small, with an ample margin reflected upwards all round, excepting behind, where for a short space it is not continuous. The margin is waved and smooth, but on the under side, where reflected, especially near the branchiæ, are several small, pointed tubercles. The whole area of the cloak is fiddle-shaped, widening considerably towards the branchiæ, and nearly smooth: an elevated ridge runs down the centre of the back, and a faint transverse one usually intersects it about half way down. *Dorsal tentacles* small, placed much forward on the head, and generally thrown back when the animal is at rest, but when it is in action they are much more elevated: the base is smooth and brownish, with three or more longitudinal interrupted lines of white, above which there are ten or eleven broad laminae of a brown colour, blotched with darker brown and white, coming to a peak behind, but not reaching to the front of the tentacle, which is smooth: the apex is a small cylindrical style, truncated at the top, and blotched with opake white. *Branchiæ* large, consisting of seven or nine plumes, forming nearly a complete circle round the anus. The plumes are dark purplish brown spotted with white, tripinnate, and frequently divided into two branches at the top. A waved tuberculated ridge extends from the termination of the cloak to the tail, which is rather obtuse. *Foot* broad, extending much beyond the cloak, and having the upper part strongly tuberculated and blotched with opake white. It is deeply notched under the mouth in front, and rounded at the sides: the colour of the under side is yellowish, with a tinge of purple, and sprinkled with minute white and brown spots, the liver appearing indistinctly through the centre of a dark purple colour.<sup>1</sup>

We discovered a single specimen of this very distinct and interesting *Goniodoris* in the summer of 1845, under a stone at low-water mark near the ruins of Salcombe Castle, Devonshire. Since then it has been found more plentifully at Saltcoats, on the Ayrshire coast, by our young friend, Mr. David Landsborough, jun., to whom we are indebted for

## GONIODORIS CASTANEA.

some fine specimens, as well as for a knowledge of its spawn, which is deposited in the months of June and July on the under side of stones, forming a spiral ribband of two volutions.

The skin is well supplied with spicula, resembling in form those of *G. nodosa*, but rather more bent and nodulous.

This species is rather inactive in its habits, though occasionally it crawls about pretty freely, and frequently swims inverted on the surface of the water in the usual manner.

- Figs. 1, 2, 3. Different views of *Goniodoris castanea*.  
4, 5. Front and side views of a dorsal tentacle.  
6. A branchial plume, much magnified.  
7. A portion of the skin from the side, much magnified.  
8. A few of the spicula, highly magnified.  
9. Spawn.  
10. A portion of the same, more highly magnified.

### GENUS 3. TRIOPA,\* JOHNSTON.

*Corpus* limaciforme, subdepressum, postice acuminatum, pallio parvo appendicibus linearibus marginato obtectum. *Caput* inferius, sub pallio absconditum, tentaculis 2 labialibus instructum. *Tentacula* dorsalia 2, laminata, intra vaginas retractilia. Branchiæ plumosæ, in lineâ mediâ dorsi anum præpositæ. Apertura genitalis ad latus dextrum.

The type of this genus is the *Doris clavigera* of Müller, a species long known to naturalists by the figures and description of that author, though their familiarity with the living mollusk is but of recent date.

It was raised to the rank of a genus, under the above name, by Dr. Johnston in his account of the 'Scottish Mollusca Nudibranchia,' published in the first volume of the 'Annals of Natural History' in 1838; but characterised rather loosely, in order, as the author informs us, to embrace another species, which, however, has turned out to belong to the genus *Polycera*. In redescribing it, we have, therefore, found it necessary to make a considerable alteration in the original generic character. In the first volume of the 'Enumeratio Molluscorum Siciliæ,' published in 1836, Dr. Philippi has described a genus under the name of *Euplocamus*, founded upon a Mediterranean species, differing only from this in the branched nature of the marginal appendages of the cloak, which he considers to be additional branchiæ, and in the absence of distinct oral tentacles. The genera are probably distinct; but however that may be, the name of *Triopa* must be retained, as that of *Euplocamus* had been previously used for a genus of insects. M. Philippi has since united his genus with the *Idalia* of Leuckart, a proceeding in the propriety of which we do not coincide.

The only two species of *Triopa* at present known are inhabitants of the seas of Northern Europe. Two species of *Euplocamus* are found in the Mediterranean. Yellow appears to be the predominant colour in all of them.

The form of the body, and the marginal processes of the cloak, in *Triopa*, indicate an approach to the *Tritoniadæ*, which is further carried out by these processes assuming a branched form in *Euplocamus*, having a considerable resemblance to the branchial tufts in *Tritonia*. And, assuming that the lateral processes are of a branchial nature, *Triopa* may be considered to make an approach to that section of the *Eolididæ*, which have a posterior dorsal anus (the *Proctonotinæ*), for in them the branchial papillæ pass round the front of the head in the same manner as the processes do in this genus. The head and oral tentacles have also some similarity to those of *Antiopa*. In its well defined cloak, rough with spicula and tubercles, *Triopa* shows, on the other hand, a near affinity to *Doris*. We have been chiefly influenced by the character of the lingual plates, and the disposition of the branchial plumes, in giving it a place amongst the *Polycerinæ*.

\* The name of a son of Neptune.

## TRIOPA.

The body of *Triopa* is elongated and rather depressed, tapering posteriorly. The cloak is small, exposing the foot, rounded and extended over the head anteriorly, and terminating in a point behind. Its margin is adorned with numerous linear, subclavate processes. The head is inferior, with two shortish labial tentacles: the mouth is not furnished with jaws. The two dorsal tentacles are laminated and retractile within small sheaths. The branchiæ are plumose, generally few in number, and placed immediately in front of the vent, partially surrounding it at the base, on the median line of the back. The foot is moderately sized, nearly linear, and deeply sinuated in front. The aperture of the genital organs is simple, situated on the right side about one third down the body.

Our observations on the anatomy of this genus must be confined to that of *T. claviger*, the only one we have had an opportunity of dissecting.

The buccal organ is rather small, and less muscular than usual; the channel leading to it from the external opening, which is situated on the under surface of the head, is very short: there are neither jaws nor prehensile collar, and the tongue is formed on the type of that of *Polycera*, but is somewhat broader; it is of a pale yellow colour, and is divided down the centre by a naked space: the tubular portion behind projects, slightly from the posterior end of the buccal organ. The plates are numerous and are arranged in about forty-five rows of twenty-two plates each; the ten external ones are much depressed, of a square form, and set close together; the two on each side of the median line bear large curved spines, the innermost being much attenuated, the other very stout and with a single denticle near the point.\*

The œsophagus, which is of no great length, passes from the buccal organ above and behind, and has at its origin a pair of tubular salivary glands, which open into the mouth in the usual way. At first the alimentary tube is much constricted, but immediately on passing through the nervous collar, it is suddenly enlarged a little, and soon afterwards contracting slightly, is continued backwards, of equal caliber, to the anterior border of the liver, into which it plunges, the stomach being buried in that viscus. The intestine is short; it issues from the upper surface of the hepatic organ towards the left side, and, passing across towards the right, pursues its path, almost in a straight line, to the anus.

The reproductive organs are similar to those of *Ægirus*. The glandular portion of the testis and the spermathecæ are, however, somewhat modified in form. The oviduct too is rather peculiar: at first it is much attenuated and then, as usual, becomes suddenly and much enlarged; but afterwards contracts again at a considerable distance from its junction with the testis. The ovary covers the upper surface of the liver, giving to that organ a very distinct tessellated appearance: it is composed of a number of large globules surrounded by smaller ones; the latter are yellowish, and contain ova; the former are pale in colour, and filled with spermatozoa.

The vascular system does not appear to differ from that of the other *Polycerinæ*,—the pericardium, ventricle, auricle, and portal heart exhibiting no peculiarity. The renal organ has not been observed.

\* We have had an opportunity of examining the buccal organ of *Euplocamus croceus*, which differs from that of *Triopa claviger* in having a prehensile collar, and a much broader tongue, with very numerous plates; three of the inner ones on each side bear large blunt spines.

## TRIOPA.

The ganglia of the nervous system resemble those of *Ægirus*. There are two pairs of œsophageal centres, the median and upper one being composed of two large oblong masses, placed close together, and united above the alimentary tube. These masses are formed by the fusion of the cerebroid and branchial ganglia. They distribute their nerves almost exactly as in *Ægirus*, and the olfactory nerves have at their origin each a considerable ganglionic enlargement. The pedial ganglia rest against the sides of the œsophagus, and are united below that tube by a short commissural cord,—the great œsophageal collar: they give three nerves to the foot. A visceral nerve comes off from a small ganglion, closely attached to the branchial portion of the right central mass.

The buccal ganglia are in close contact with each other; and are united to the upper or central masses by shorter cords than usual.

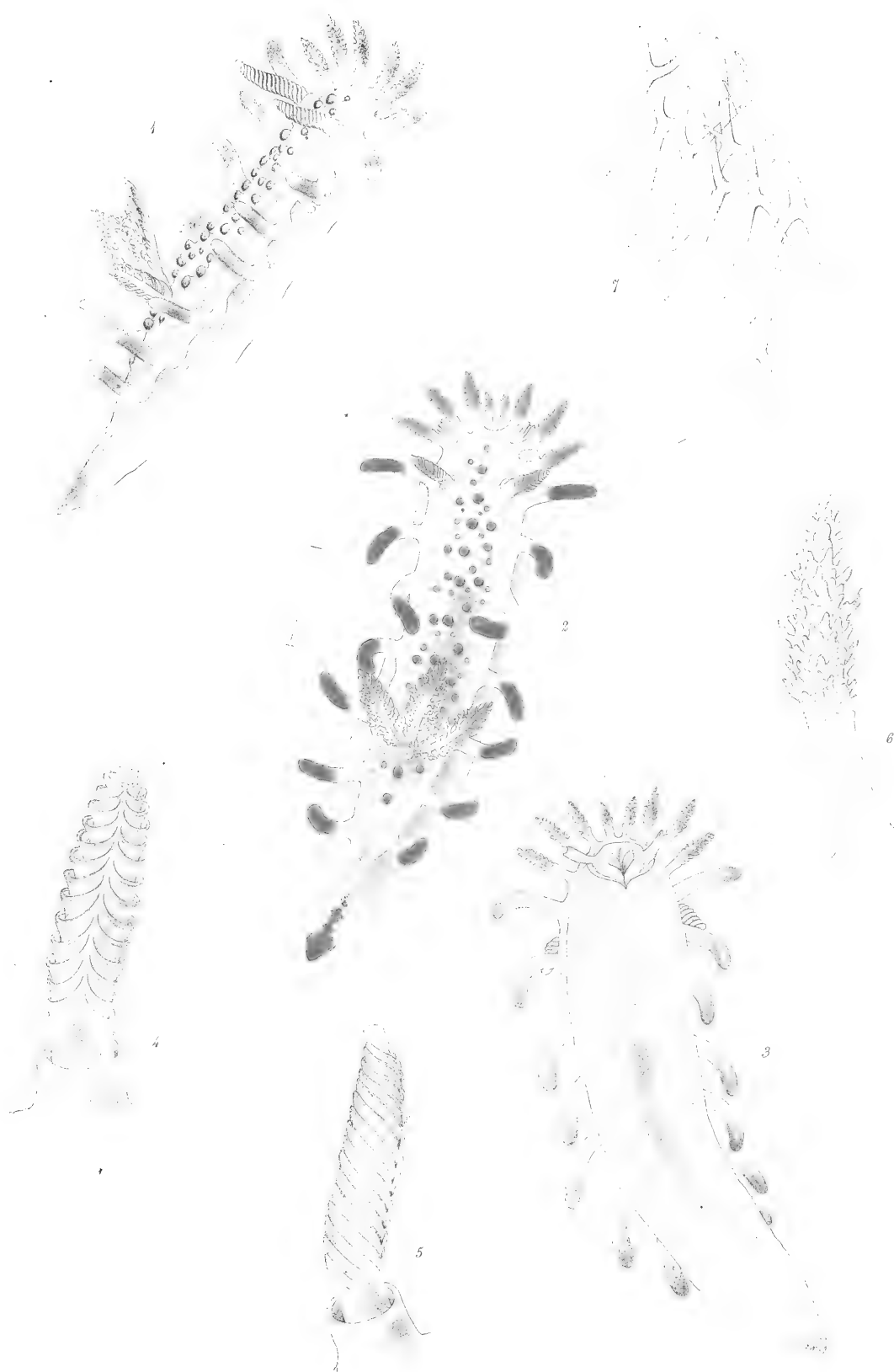
The eyes, which are of the usual character, receive their nerves from minute elliptical ganglia, attached to the external margins of the cerebroid portion of the central masses. The auditory capsules are situated at the junction of the same masses with the pedial ganglia, and appear to belong to the cerebroid portion of the former. They contain numerous elliptical otolithes.

The skin is much stiffened and crowded with spicula, which are large, strong, and generally bifurcated at one end.









A. Hancock del H. Holmes lithogr.

C. Hullmandel's Patent.

*TRIOPA CLAVIGER.*

## Fam. 1, Plate 20.

### TRIOPA CLAVIGER, MÜLLER, *Sp.*

*T. albus*, dorso tuberculis aurantiacis : appendicibus linearibus pallii flavo-terminatis : tentaculis subclavatis, flavis : branchiis 3, bipinnatis, flavo-terminatis.

*Doris clavigera*, Müller, Zool. Dan. Prod. 229.

Idem, Zool. Dan. v. 1, p. 17, pl. 17, f. 1-3.

Gmel., Linn. Syst. Nat. p. 3104.

*Tergipes pulcher*, Johns., in Loud. Mag. Nat. Hist. v. 7, p. 490, f. 59.

*Euplocamus plumosus*, Thomp., in Ann. Nat. Hist. v. 5, p. 90, pl. 2, f. 4.

*Euplocamus claviger*, Idem, in Report Brit. Assoc. for 1843, p. 250.

*Triopa claviger*, Johns., in Ann. Nat. Hist. v. 1, p. 124.

Lovén, Index Moll. Scand. p. 6.

*Hab.* At different depths, from twenty fathoms to within tide-marks, on most of our coasts. Berwick Bay, *Dr. Johnston*. Cullercoats, not common, and always from deepish water. Loch Strangford, and Lahinch, Co. Clare, Ireland, *W. Thompson, Esq.* Isle of Man; and Bressay Sound, Shetland, *Professor E. Forbes*. Whiting Bay, Isle of Arran, *D. Landsborough, Esq.* Not uncommon near low-water mark, Torbay; Salcombe Bay, Devonshire; Fowey Harbour, and Helford River, Cornwall, *J. A.*

*Body* from half to three quarters of an inch in length, elongated, depressed, rounded in front, nearly parallel at the sides, and tapering to an obtuse point behind; white, with all the processes tipped with yellow or orange: a line of yellow spots generally runs between the cloak and foot to the tail, and on the latter is a central streak of the same colour. *Cloak* indistinct, white; with a few scattered, obtuse, orange or scarlet tubercles, of unequal sizes, on the back; the margin surrounded by about twenty longish, linear or subclavate appendages, each terminated with yellow or orange: six or seven of these are arranged on each side; they are obtuse, and usually curved towards the back, in a greater or less degree, according to the will of the animal, which has the power of moving them either together or separately. Those round the front are of smaller size, taper gradually to a point, and are generally a little branched or tuberculated towards the end: they are about eight in number, the two central ones smallest. *Dorsal tentacles* set far apart, linear or subclavate, laminated to near the base with about fourteen or fifteen plates; they are yellow on the laminated part, and transparent white below. Sheaths small, plain, and rather tight. *Head* rather small, with two short cylindrical oral tentacles, truncated at the end, longitudinally folded, and open along the upper side. *Branchial plumes* three, rather long, narrow, and elliptic; bipinnate, transparent white tipped with yellow. *Foot* transparent white, with a narrow longitudinal patch of pinkish-brown, from the liver, in the centre. It is truncated and deeply indented in the middle in front, and terminates in an obtuse point behind.

#### TRIOPA CLAVIGER.

The skin is densely filled with spicula, which are of various forms ; generally forked or triradiate, occasionally straight, and a few cruciform or dagger-shaped. The latter are mostly found in the branchiæ, and those of the first description are most developed in the lateral processes.

Dr. Johnston was the first to notice this handsome species as a native of Britain, and it has since been found to be pretty generally diffused. It varies a little in appearance, which has induced some naturalists to think that more than one species might be included in it, but no good distinguishing characters have yet been pointed out. The four branchial plumes described and figured by Müller, are so unlike the usual appearance of those organs in the *Dorididæ* that it is fair to conclude they have been misunderstood. The specimens found on the Northumberland coast are much smaller, and have the branchiæ much less developed than those from the south of England ; the appendages of the cloak, too, are more clavate, and the orange colour does not extend so far down them. This form is probably the *T. pulcher* of Johnston, which is stated to have tubercular branchiæ ; a mistake arising from the difficulty of observing them, on account of their minuteness and transparency.

- Figs. 1, 2, 3. *Triopa claviger*, different views.  
4, 5. Front and side views of a tentacle.  
6. One of the frontal appendages much magnified.  
7. Spicula.

#### GENUS 4. ÆGIRUS,\* LOVÉN.

*Corpus* robustum, gibbum, postice attenuatum, vix palliatum, tuberculis validis, prominentibus undique instructum. *Caput* inferius, subtentaculatum, maxillâ unicâ superiore. *Tentacula* 2 dorsalia, cylindrica, simplicia, intra vaginas retractilia. *Branchiæ* plumosæ, in lineâ mediâ dorsi anum circumdantes. Apertura genitalis ad latus dextrum.

Professor Lovén established this genus in 1844, in the 'Proceedings of the Royal Swedish Academy,' for a curious little mollusk, the *Polycera punctilucens* of D'Orbigny, at present the only known species. Its most striking characteristic is the large wart-like tubercles with which it is covered, but it differs from *Polycera*, and apparently from all the known genera of the *Dorididæ*, in having smooth, unlamellated tentacles; and instead of having two lateral jaws, as in several of the other Nudibranchs, it has a single dorsal one, a character in which it resembles the land slugs.

The body of *Ægirus* is stout and rather gibbous, tapering to an obtuse point behind. It is studded with large and prominent tubercles, which extend over the whole of the upper surface. There is no distinct cloak, but the rudimentary margin of one may be readily traced, projecting over the head in front, and running along the sides of the body to the branchial plumes. The head is inferior, and has on each side a flat tentacular appendage. There is only a single jaw, which forms an arched corneous plate on the upper side of the mouth. The two dorsal tentacles are linear and smooth, and are retractile within lobated sheaths. The branchiæ are plumose, surrounding the vent on the median line about one third down the back. They are protected anteriorly and laterally by large lobed tubercles. The foot is nearly linear, square in front, and obtusely pointed behind. The aperture of the sexual organs is on the right side.

In internal organisation, *Ægirus* resembles *Polycera* as closely as it does in external form: there are, however, some very interesting modifications of detail, particularly in respect to the buccal armature.

The mouth opens on the under surface of the head, and the channel leading to the buccal organ is very short. This latter organ is firm and muscular, but rather small: it is furnished with a single horny plate or jaw (Pl. 17, fig. 14 *d*, and fig. 15), situated in the buccal lip above, holding exactly the same position, and apparently acting in the same manner as the horny jaw or tooth of *Limax*. This is the only instance among the Nudibranchs in which we have detected an upper jaw. It is lamelliform, rounded above, and has the lower or cutting margin, which projects downwards, truncated, thickened, and produced into an obtuse point in the centre. The orifice of the buccal organ is guarded below by two lateral fimbriated membranes (fig. 14 *e*), angulated above. The tongue is broad, as in *Doris tuberculata*, having nineteen rows of amber-coloured, simple, compressed spines, thirty-eight or forty in

\* From *Ægir*, the god of the Ocean, in northern mythology. Professor Lovén originally wrote the name of the genus *Ægires*, but in a more recent publication he has changed the termination to *us*, which we adopt as more consonant with classical usage.

## ÆGIRUS.

each row: the median spine is deficient, and the tongue is divided down the centre by a narrow naked space. The tubular portion behind projects a little backwards from the buccal organ. A pair of tubular salivary glands open into the mouth at the sides of the œsophagus. This latter organ is rather short, and passes from the upper posterior end of the buccal mass: it is of equal caliber throughout, with the exception of a slight swelling immediately after it passes through the nervous collar: it enters the liver in front, to join the stomach, which is small, and buried in that viscus. A portion of the upper surface of the gastric pouch is seen, however, emerging upwards from the biliary organ, and gradually subsiding into the intestine, which is short. At the junction of this tube with the stomach, there is a small oval sac—a rudimentary pancreas—and at the other extremity, a gland-like body; but this latter does not appear to be connected with the alimentary tube, and we have not succeeded in determining its nature.

The reproductive organs are much like those of *Polycera*. The testis is composed of a tubular, and a large, irregularly rounded, glandular portion; the intermediate thin duct-like tube not being present. The spermathecae are oval, the principal one being large, the other very small.

There is nothing peculiar in the vascular system, so far as we have been able to examine it, and the renal organ, though observed, has not been sufficiently made out.

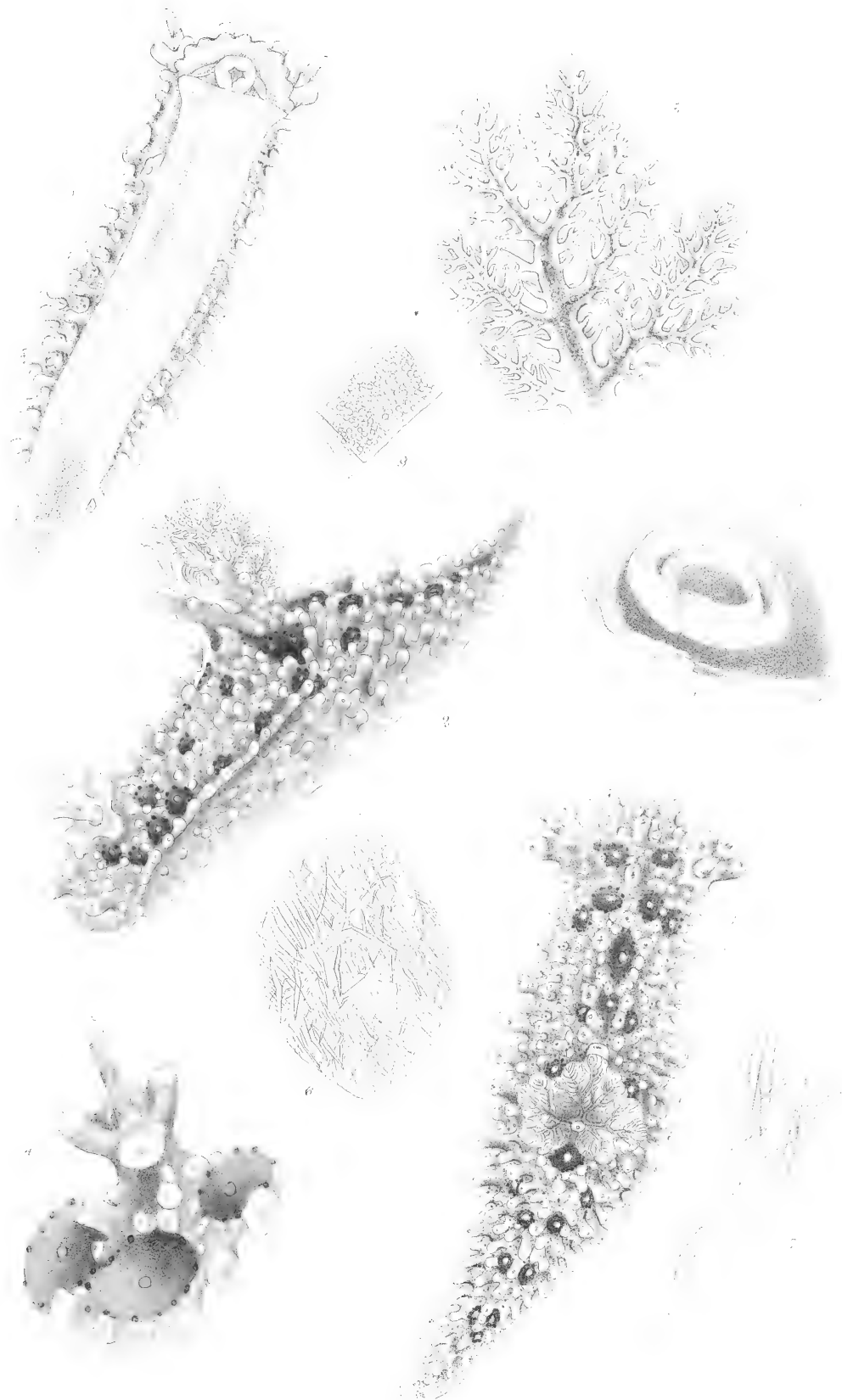
The nervous system is more highly concentrated than in *Polycera*. There are only two pairs of principal œsophageal ganglia,—the cerebroid and branchial being completely fused, so as to form, above the alimentary tube, two large reniform masses, which are united to each other by a very short commissure across the median line. The anterior portions of these masses represent the cerebroids, and accordingly each gives off from the frontal margin three nerves, which supply the channel of the mouth and the oral tentacular appendages. The olfactory ganglia are large and oval, being equal in size to the buccal; they are closely adherent to the frontal margin of the same ganglia, but a little nearer to the median line. The nerves they supply are stout, and go direct to the dorsal tentacles. The posterior portions of the large central masses are the branchial ganglia, and from the outer margin of each a couple of nerves are sent off, which, branching forwards and backwards, go to the dorsal skin: the anterior branch supplies the veil or mantle-border overhanging the head. From the right branchial, two additional nerves are given off; one of which, coming from the outer margin, passes to the male sexual organ; the other is given off from the under side. These are all we have detected of the visceral nerves. The pedial ganglia are rounded in form, and are closely attached to the outer margin, below, of the two large central masses: they are placed at the sides of the œsophagus, and are united below that tube, by a rather long, stout cord,—the great œsophageal collar, composed, in this instance, of three filaments, two of which are, as usual, pedial—one branchial: three nerves are given by these ganglia to the foot.

The buccal ganglia present nothing unusual; they are joined together across the median line by a short commissure. The gastro-œsophageal ganglia have not been observed.

The eyes are sessile on the outer margin of the anterior or cerebroid portions of the central ganglionic masses. The auditory capsules are attached to the under side of the same portions immediately behind the eyes, and contain numerous elliptical otolithes, and a single spherical one, much larger than the others.

The skin is tough and coriaceous, having the imbedded spicula much more crowded than in any other of the *Polycerinae*: they are fusiform, pointed at both ends, and bent in the centre.





A. Hancock del. H. Holmes lithogr.

C. Hullman del. H. Holmes lithogr.



## Fam. 1, Plate 21.

### ÆGIRUS PUNCTILUCENS, D'ORBIGNY, *Sp.*

*Æ. gibbosus*, purpureo-fuscus, tuberculis validis, truncatis obtectus; punctisque splendidibus, viridi-cæruleis, maculis brunneis circumdatis, ornatus: tentaculis luteolis, intra vaginas quinque-lobatas retractilibus: branchiis tribus albidis.

*Polycera punctilucens*, D'Orb., in Mag. de Zool. v. 7, p. 7, pl. 106.

Thompson, in Ann. Nat. Hist. v. 15, p. 313.

*Ægires punctilucens*, Lovén, in Öfv. K. Vet. Förl., 1844, p. 49.

Idem, Index. Moll. Scand. p. 6.

*Doris Maura*, Forbes, in Ann. Nat. Hist. v. 5, p. 103, pl. 2, f. 17.

*Hab.* Under stones among rocks near low-water mark. Courtmasherry Harbour, Co. Cork, Professor Allman. Ardrossan, Ayrshire, J. A. Isle of Arran, J. A., and D. Landsborough, jun. Pridmouth, near Fowey, Cornwall, C. W. Peach. Devar Island, Campbeltown (*Doris maura*), Professor E. Forbes.

*Body* from half to three quarters of an inch long, rather gibbous, broadish and truncated in front, swelling in the centre, and tapering to an obtuse point behind. The back and sides are covered with soft elevated tubercles, conical at the base, and expanded, flattened, and mammillated at the top, in the centre of which there is a reddish spot. These tubercles are disposed somewhat symmetrically:—a crest of two or three, united into a line, runs between the tentacles, before which there are three large ones, and behind this line a row extends along each side of the ridge of the back to the branchiæ. Three much larger than the rest, and branched, surround the branchiæ in front, and a line of tubercles also runs along the posterior ridge to the tail. On the sides they are disposed in lines; one of which on each side, more distinct than the rest, runs from the sides of the veil to the posterior ridge behind the branchiæ, forming a subpallial margin. The whole of the body, with the exception of the areas afterwards mentioned, is of a purplish-fawn colour, occasionally inclined to a rosy hue, sprinkled over with very minute white spots, interspersed with larger ones of a dark brown colour approaching to black; there are a few whitish blotches near the tentacles, and a streak of opaque white on the back, immediately in front of the branchiæ. The sides of the foot are marked with darkish radiating lines of the same colour as the body. Between the tubercles there are placed symmetrically over the body smooth areas of a rich velvety brown, with a brilliant greenish-blue spot of gem-like lustre in the centre of each. These areas are studded round with dark chocolate brown or black spots; they are of different sizes, and placed as follows:—there are two on each side, sloping diagonally outwards before the tentacles, behind them are other two sloping backwards towards the sides, and further back a large oval or lozenge-shaped one on the centre of the back, and one or two small ones behind, with others at the sides. Two large irregular areas are situated on each side before the branchiæ, and a very large heart-shaped central one

## ÆGIRUS PUNCTILUCENS.

behind them. Smaller ones occupy each side of the ridge to the tail. *Dorsal tentacles* stout, linear, smooth, slightly compressed at the sides, and terminating in a blunt double apex, the posterior half rising a little above the other: they are yellowish, sprinkled with white, and having two or three transverse brown bands. Sheaths moderately sized, divided into five mammilliform lobes, the external ones very large, the internal smaller. *Branchial plumes* three, imperfectly tripinnate, of an obscure pellucid white, with a pale brown line running along the principal stem and branches; the whole minutely streaked with opaque white. The two lateral plumes have each a large posterior branch. *Head* indistinct, covered by a small veil, the margins of which are scalloped into about eight or ten equal tubercles: mouth tubular, situated in a depression between the veil and foot; the lips fleshy, and outside of them two indistinct oral tentacles. *Foot* whitish, with the sides nearly parallel, squared in front, and slightly produced laterally into obtuse points.

The spicula of the skin are very numerous, and crowded together without much apparent order; they are of different sizes, smooth, swelling a little and slightly bent in the centre, and tapering to a point at each end.

The *Doris Maura* of Professor E. Forbes, which we consider to be a variety of this species, has the colour of the body darker, and the tubercles pinkish. We found a variety somewhat similar in Lamlash Bay, Isle of Arran.

This interesting and curious animal has at first sight rather an unattractive appearance, and it is not until we examine it more carefully that its beauty becomes apparent. The brilliant spots with which it is covered, give it the appearance of being studded with small gems, each set in a dark frame. They vary from azure blue to emerald green, reflecting either colour occasionally according to the light they are viewed in.

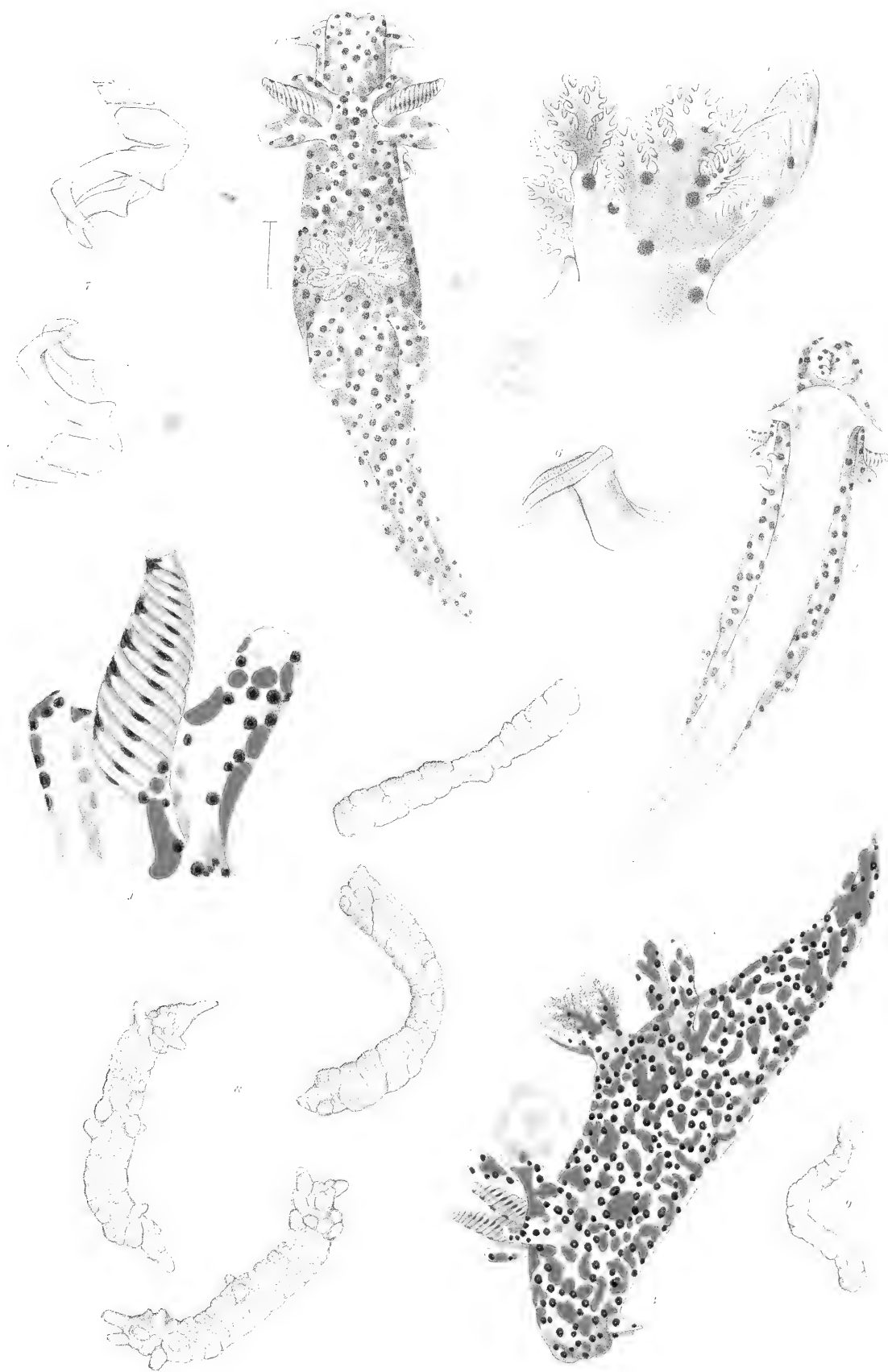
*Ægirus punctilucens* has now been met with in several localities on our southern and western coasts, and, though by no means common, appears to be pretty extensively diffused. M. D'Orbigny first described it from a specimen found near Brest, and it has also been found on the Swedish coast, where it appears to be more common than with us, as Professor Lovén remarks that it is sometimes gregarious. It is a sluggish animal, though the individuals we have met with are certainly much less so than the one observed by M. D'Orbigny, which took five hours to traverse a vase little more than a decimeter in diameter. According to the observations of that naturalist, it feeds upon small species of *Ulvæ*.

The spawn of *E. punctilucens* consists of a narrow gelatinous riband, cemented by its edge to stones, and forming a spiral coil of two volutions. The ova are small, and placed in close transverse lines of about ten each.

Figs. 1, 2, 3. *Ægirus punctilucens*, different views.

4. A tentacle more highly magnified, and exhibiting three of the brilliant spots at its base.
5. A branchial plume.
6. A portion of the skin with spicula.
7. Detached spicula, more highly magnified.
8. Spawn.
9. A portion of the same showing the ova.





## Fam. 1, Plate 21 *a*.

### THECACERA PENNIGERA, MONTAGU, sp.

*T. albida*, aurantiaco nigroque maculata; vaginis tentaculorum patulis, lobatis; branchiis 3 tripinnatis; appendicibus branchialibus, 1 utrinque, clavatis; angulis anterioribus pedis productis.

*Doris pennigera*, Mont. in Linn. Trans., v. 11, p. 17, pl. 4, fig. 5.

*Thecacera pennigera*, Flem. Brit. Anim., 283.

Forbes and Hanley, Brit. Moll., v. 3, p. 575.

*Hab.* Rocks at low-water mark, Milton, Devonshire, *Montagu*. Cornwall, *R. Q. Couch, Esq.* Weymouth, *W. Thompson, Esq.*

*Body* half an inch long, nearly linear, much rounded above, and tapering to a point behind; transparent white, tinged with yellow from the viscera appearing through, and covered with irregular bright orange blotches and spots, interspersed with smaller spots of velvety black, slightly inclining to puce-colour; these latter are pretty evenly circular, with granulated margins, which, in Montagu's specimens, assumed a radiated appearance under a lens. *Tentacles* rather stout, linear, laminated with about fourteen plates, terminating in a narrow ridge in front; yellow, with black spots. They issue from wide sheaths, forming an expansion on the outside of each tentacle, which it encircles for nearly two thirds of the circumference, terminating abruptly towards the inside. The margin is plain, rising into a strong, blunt process behind; the anterior side is very slightly elevated. *Head* narrow, without oral tentacles or distinct veil, and slightly notched in front from an extension of the groove formed by the buccal aperture. *Branchial plumes* three, tripinnate, rising from a common footstalk near the middle of the back. They are transparent white, with orange and black blotches and spots. *Branchial appendages* one on each side, set at a little distance behind the branchiæ, linear or subclavate, rounded at the top, blotched and spotted with orange and black (in Montagu's specimen they were bifid, but this is most likely an accidental variety). *Foot* linear, very narrow, transparent white, strongly grooved in front, and notched on the upper lamina; the angles produced into sharp tentacular points at the sides.

*Spicula* robust, linear, with the extremities pointed and bent in the same direction, irregularly nodulous; the nodules larger in the centre, and towards the extremities. Their form, however, varies considerably; some are regularly arched in the centre, with the ends truncate, others are almost straight; some again have their extremities furnished with two or more obtuse points, while specimens occur much angulated and irregularly bent in the centre, with the ends rounded, enlarged, and recurved.

Having for several years sought for this interesting species in vain, we had despaired of being able to give figures of it, when Mr. Wm. Thompson, of Weymouth, had the good fortune to meet with it at that place, and kindly sent us a living specimen. We are thus enabled to

## THECACERA PENNIGERA.

fill up the only gap that would otherwise have remained in our illustrations of generic forms. This "singular and gaudy animal" as Montagu has not inappropriately called it, attracts the observer at first sight by the decided character of its orange and black markings, which give it a harlequin-like appearance. The specific character inserted in our Synopsis, which was printed off before we had seen the animal, will be found to differ in some respects from that given above. The former was taken from Montagu's description and figure, which we had not perfectly understood. The "anterior end" "extending each side into an angular lobe," we had taken to be a bilobed veil; but this appearance is caused by the extended angles of the foot, which in the figure are represented as forming a part of the head. Montagu has also made a mistake, as Mr. Thompson has pointed out,\* in the number of the branchial plumes; in this respect departing from his usual accuracy.

Two specimens were obtained by Mr. Thompson at Weymouth, in the summer of 1854, by dredging, in about ten fathoms water. The first, he states, lived with him about six weeks; the second, which was sent to us, survived a considerable time, though in a sickly state. Mr. R. Q. Couch informs us that he found two specimens of *Thecacera pennigera* several years ago on the Cornish coast.

The jaws and tongue of this species very closely resemble those of *Polycera quadrilineata*.

Fig. 1, 2, 3. *Thecacera pennigera*, different views.

4. A tentacle with sheath.

5. Two of the branchial plumes, much enlarged.

6. A jaw.

7. A row of lingual spines.

8, 9. Spicula.

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\* Ann. Nat. Hist., 2d series, v. 14, p. 237.

GENUS 5. THECACERA,\* FLEMING.

*Corpus* limaciforme, læve, non palliatum, postice acuminatum. *Caput* subinferius, velo aut plano aut lobato sepiissimè obtectum. *Tentacula* 2 dorsalia, laminata, intra vaginas retractilia. *Branchiæ* plumosæ, in lineâ mediâ dorsi anum circumdantes, appendicibus lateralibus linearibus vel tubercularibus. Apertura genitalis ad latus dextrum.

*Thecacera* is very nearly allied to *Polycera*, from which it chiefly differs in having sheathed tentacles; the laminated character of these organs, together with the smooth surface of the body, sufficiently distinguish it from *Ægirus*; and with other genera of the group it cannot readily be confounded. The genus was proposed by Dr. Fleming in his 'History of British Animals' (1828) for the *Doris pennigera* of Montagu, a rare and curious Mollusk, then only known by the description of the latter author, and even up to the present time involved in much obscurity; but possessing characters, which, Dr. Fleming very properly observed, "mark it as the type of a genus." Another species has lately been discovered by Mr. Cocks at Falmouth; and more recently still, a third species has been dredged off St. Ives by Mr. Barlee. These agree with that of Montagu, in the smooth body, and laminated and sheathed tentacles, but vary in almost every other respect from the typical form.

The only known foreign species of this genus was found by Mr. Charles Darwin in the Chomos Archipelago, south of Chiloe, and is not yet published.

*Thecacera* has the body limaciform and smooth, swelling a little in the centre, and terminating in a pointed tail. The head is sub-inferior and furnished, like *Polycera*, with corneous jaws: it is generally covered by a velar expansion, more or less distinct, and of variable character, being either even, lobed, or tuberculated. The tentacles are two in number, dorsal, and laminated; retractile within even or foliated sheaths. There is no dorsal area or rudimentary cloak. The branchiæ are plumose, surrounding the vent in the centre of the back posteriorly. They are furnished with one or more appendages on each side, which in some species are large and well developed, in others tubercular and obscure. The foot is of the usual form, and co-extensive with the body. The aperture of the sexual organs is on the right side.

The anatomy of *Thecacera* appears to be very similar to that of *Polycera*; but on account of the rareness of the genus, we have not been able to examine it in detail. We have ascertained, however, some particulars respecting the buccal apparatus and the nervous system.

The buccal organ and jaws of *T. virescens* closely resemble those of *Polycera Lessonii*, the jaws having very imperfect cutting edges: in *T. capitata* the jaws are, however, more like those of *P. quadrilineata*. The tongue of the former species has eighteen or nineteen rows of

\* From *θήκη*, a sheath, and *κέρας*, a horn.

## THECACERA.

plates, seven in a row on each side, and can be distinguished from that of *P. ocellata* only by the external plates, which are a little squarer and broader than in that species: the two spiniferous plates next the median line are perfectly alike in both these forms, and the tongue is divided down the centre by a naked space, in precisely the same manner.

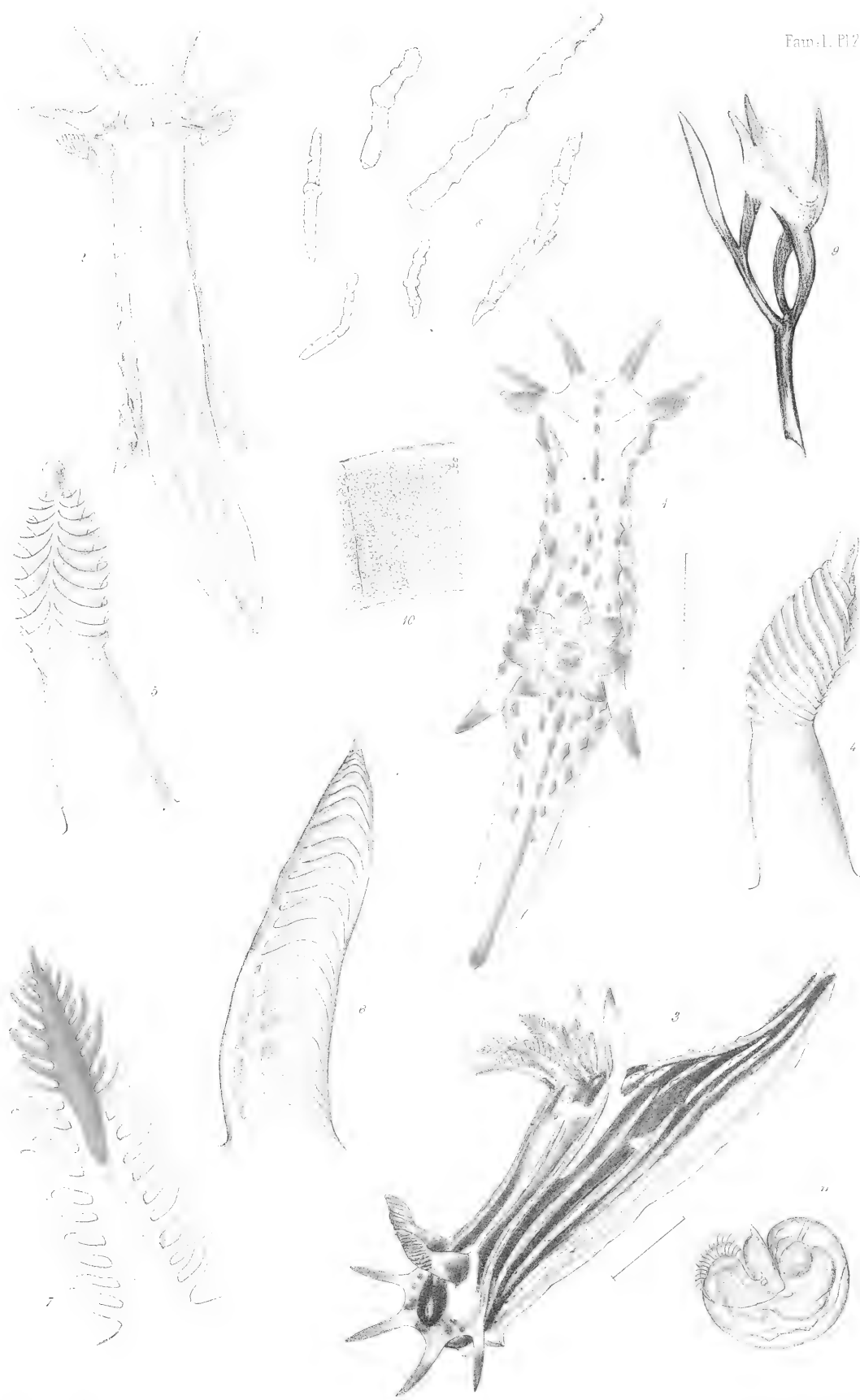
The nervous system has three pairs of cesophageal ganglia, arranged as in *Polycera*, only the cerebroids are a little elongated in the antero-posterior direction, and the buccal ganglia are closely united together.

The nerves appear to be distributed as in that genus; the eye is provided with a lens and cornea, and is sessile on the cerebroid far forward on the outer border; the auditory capsules contain numerous otolithes, and seem to belong to the same ganglia.

The skin is fine and smooth;—the spicula have not been examined.







A. Hancock del. W. Wing sculp.

C. Bulmændel's Patent Lithogr.

POLLICERA QUADRILINEATA.

## Fam. 1, Plate 22.

### POLYCERA QUADRILINEATA, MÜLLER, *Sp.*

*P. alba*, seriebus 4—9 longitudinalibus tuberculorum flavorum notata; velo cuspidibus 4, elongatis, flavo terminatis; branchiis 7—9, pinnatis, lobis branchialibus, utrinque 1, linearibus.

*Doris quadrilineata*, Müll., Zool. Dan., v. 1, p. 18, pl. 17, f. 4—6, and v. 4, p. 23, pl. 138, f. 5, 6.

Gmel., Syst. Nat., v. 1, p. 3104.

*cornuta*, Abildg., Zool. Dan., v. 4, p. 29, pl. 145.

*flava*, Mont., in Linn. Trans., v. 7, p. 79, pl. 7, f. 6.

*Polycera lineata*, Risso, Hist. Nat. de l'Eur. Merid., v. 4, p. 30, pl. 1, f. 5.

*flava*, Flem. Brit. Anim., p. 283.

*ornata*, D'Orb. in Guer. Mag. de Zool., v. 7, p. 9, pl. 107.

*typica*, Thomp., in Ann. Nat. Hist., v. 5, p. 92, pl. 2, f. 5.

*quadrilineata*, Idem., pl. 2, f. 6.

Alder, in Ann. Nat. Hist., v. 6, p. 338, pl. 9, f. 1—6.

Verany, Cat. Anim. Inv. Gen., p. 16.

*cornuta*, Lovén, Ind. Moll. Scand., 6.

*Hab.* Among small sea-weeds in pools between tide-marks, and in shallow water. Coasts of Devonshire and Cornwall, frequent. Scarborough, plentiful, *J. A.* Strangford Lough, *W. Thompson, Esq.* Roundstone Bay, Galway, *Professor E. Forbes.* Dublin Bay and Malahide, *J. A.* Whitley and Cullercoats, Northumberland; Marsden, Durham, *J. A.* and *A. H.* Near Cumbray Island, Frith of Clyde, *Rev. D. Landsborough.* Isle of Man, *J. A.*

*Body* from half to three quarters of an inch in length, nearly linear, slightly compressed, swelling a little in the middle, and tapering to a point behind; smooth, transparent, and usually white, but sometimes spotted or lineated with black, and always with rows of yellow tubercles. *Tentacles* linear or subclavate, broad at the base, and a little bent backwards above, with the mucro much produced; the upper half is yellow, with about nine or ten laminæ, nearly meeting in front; the lower part is smooth, and usually white, but, in some of the varieties, black. Frontal veil rather expanded, and adorned with four elongated and pointed filaments of a golden yellow or orange colour. *Head* inferior, with a small lobe on each side. From the margin of the veil a row of yellow or orange tubercles runs on an elevated ridge along each side of the back to the branchial lobes; another row occupies the centre of the back, and there is also a similar row on each of the sides: these five rows have, in finely developed specimens, less perfect intermediate rows, increasing the number to nine. The tubercles are sometimes confluent, forming continuous yellow stripes, and in the variety first figured by Müller, the tubercles, in four of the principal rows, are united by black lines; hence the name of *quadrilineata*. A few tubercles, ending in a yellow line, occupy the ridge

## POLYCERA QUADRILINEATA.

extending from the branchiæ to the tail. The *branchiæ* are situated immediately behind a swelling (containing the heart) on the middle of the back: they consist of seven, or occasionally nine, simply pinnate and rather tapering plumes, the largest in front: when there are nine, the posterior pair are very small. Their colour is transparent white, tipped with yellow or orange, and with a line of opaque white extending about one third up the stem from the base. On each side of the branchial circle there is a single stout, plain, linear, pointed process or lobe, which is also tipped with yellow. *Foot* linear, white, truncated and slightly bilobed in front, and produced into short angles at the sides.

This very pretty species is subject to great variation of colour and markings. The lines of yellow tubercles, however, though varying in number, are always present. The ground colour of the body, too, is invariably white, but frequently it is minutely spotted and freckled with black, and a beautiful variety is marbled with dark reddish-brown and orange spots, and has four rich chocolate-brown bands uniting the lateral rows of orange tubercles. Another still more brilliant variety, which we dredged in Salcombe Bay in 1845, was striped with alternate bands of black and bright orange-scarlet, prettily variegated with white near the tentacles and branchial plumes (fig. 3). We have met with a similar variety, less brilliantly coloured, in Fowey Harbour, Cornwall.

The appendages are also subject to variation. Sometimes an individual occurs with six velar filaments, and occasionally with one or more of them bifid, but more frequently the number becomes less by arrest of development,—thus we have met with specimens having only one, two, or three filaments. The branchial lobes, too, are sometimes, though very rarely, wanting. The naturalist must therefore be on his guard not to be deceived by these sports of nature into the establishment of spurious species. Nevertheless we have met with a few individuals on the Devonshire Coast of a *Polycera* resembling this, but without the tubercles, and differing in so many other points that we are much inclined to consider it distinct.

There is some little difference in form between the generality of south country specimens and those got on the Northumberland Coast. In the former the tentacles and branchial plumes are more slender towards the apex than in the northern form, but we think they are probably only varieties.

The *Polycera typica* of Thompson differs from *P. quadrilineata* in nothing but the size of the branchial lobes, which in that species are large and inflated. We had at first thought that this might prove a good distinction, but have since found that these, as well as the other parts of the body of these little creatures, are apt to become inflated when they are in a sickly state, and that specimens of the ordinary kind have occasionally had the branchial lobes thus inflated after coming into our possession. We are compelled, therefore, to consider the *P. typica* only an accidental state of the present species. *Polycera quadrilineata* is widely diffused through the European seas; extending from Norway to the Mediterranean, whence specimens have been sent us by M. Verany. Our list of localities will show that its distribution round the British coast is very extensive. It inhabits the littoral and laminarian zones, and may sometimes be found congregated in considerable numbers on small sea-weeds, in pools among the rocks near low-water mark, especially in the summer months, when it is spawning. The spawn forms a small, broadish, white strap, attached by one of its edges to sea-weed, and arranged in a single imperfect coil. The eggs are very small and numerous.

## POLYCERA QUADRILINEATA.

This is rather a lively animal, and is fond of swimming in the usual inverted position. It will sometimes suspend itself from the surface by its tail, which it forms into a kind of cup for the purpose.

The spicula are few and rather small. They are nearly of uniform width, bent in the middle and rounded at the ends, and are more or less covered with warty tubercles. The heart beats from ninety to a hundred times in a minute.

Figs. 1, 2. *Polycera quadrilineata*, different views.

3. The same, a black-banded variety.

4, 5. A tentacle, profile and front views.

6, 7. A branchial plume, two views.

8. Spicula.

9. The spawn.

10. A portion of the same more highly magnified.

11. The larva.



## GENUS 6. POLYCERA,\* CUVIER.

*Corpus* limaciforme, aut læve aut tuberculatum, postice acuminatum, vix palliatum. *Caput* subinferius, subtentaculatum, velo frontali mucronato vel tuberculato, in lineam dorsalem tuberculatam utrinque continuato; maxillis corneis. *Tentacula* 2 dorsalia, subclavata, laminata, non-retractilia. *Branchiæ* plumosæ, in lineâ mediâ dorsi anum circumdantes, appendicibus linearibus vel lobatis utrinque ornatae. Apertura genitalis ad latus dextrum.

With great uniformity in general appearance, the *Polycerinae* shew so many varieties in detail that it is difficult to avoid raising almost every species to generic rank. The genus *Polycera* was instituted by Cuvier, in the 'Règne Animal,' on the type of the *Doris quadrilineata* of Müller, a species of which, though reappearing from time to time under many different names—*cornuta*, *flava*, *lineata*, *varians*, and *typica*—still remains the only animal in which the *Polyceral* (many-horned) character of the frontal expansion is distinctly recognisable. Several other species have been included in the genus, nearly all of which have since been detached to constitute different genera, and the two which form our second section might without impropriety be raised to a similar rank, were it not that we are unwilling to multiply genera on slight characters. The most available characters for generic distribution in this sub-family are the tentacles—laminated or unlaminated—sheathed or unsheathed—with or without basal filaments. The appendages adorning the branchial region are also of importance; as well as the more or less distinct cloak, sometimes only indicated by a dorsal area circumscribed by a ridge of tubercles or filaments, and occasionally almost entirely wanting. Cuvier thought that the branchial lobes covered and protected the branchiæ in times of danger, but most of these appendages are but ill adapted for such a purpose.

*Themisto* of Oken is synonymous with *Polycera*. The range of the genus is rather uncertain, but it appears to extend throughout the European seas, and probably over most of the shores of the Atlantic. Five species have been found in Norway, two in France, and one in the Mediterranean. Of extra European species, one occurs in the Canary Islands, another on the coast of North America, and a third in Rio de Janeiro.

The body of *Polycera* is limaciform, smooth or tuberculated, swelling a little in the centre, and acuminated behind. The head is subinferior and has the sides a little lobed or dilated without forming true oral tentacles. The mouth is furnished with corneous jaws, a rare circumstance in the *Dorididae*. The veil, as it is usually called, or, more properly, the frontal

\* From πολύς, many, and κέρας, a horn.

## POLYCERA.

margin of the rudimentary cloak is more or less dilated, bearing on the margin tubercles, digitations, or tentacular filaments. A ridge of tubercles, sometimes connected by a slight membrane, extends along each side of the back, from the margin of the veil to the branchiæ, terminating in one or more simple or lobed branchial appendages on each side. The tentacles, two in number, are dorsal, placed in the usual position; they are subclavate, laminated on the upper portion, and non-retractile; without sheaths or basal filaments. The branchiæ are plumose, and surround the vent about two thirds along the back, whence a central ridge extends to the tail. The foot is nearly linear. The aperture of the generative organs is simple, and placed on the right side.

The genus may be divided into two sections as follows:—

Section 1. Veil dilated into tentacular filaments; branchial appendages linear, one on each side. Type. *P. quadrilineata*.

Section 2. Veil short, bilobed and tuberculated: branchial appendages tubercular, more than one on each side. Type. *P. Lessonii*.

*Polycera quadrilineata* is generally found on *Fuci*, *P. Lessonii* on flexible zoophytes: the former is therefore probably herbivorous, the latter carnivorous.

There is not much diversity in the anatomy of the three British species of *Polycera*, though, in some respects, *P. quadrilineata* differs in its organisation from its congeners. The channel of the mouth is exceedingly short, leading almost immediately from the external opening, situated in the inferior surface of the head, into a rather large and powerful buccal organ, provided with corneous jaws, which (Pl. 17, fig. 11*b*) in the species of the second section are small, and of a sub-triangular form, with the cutting edge (*d*) feebly developed. In *P. quadrilineata*, they (fig. 10) are larger, and are pretty efficient cutting instruments, having their upper margins concave and bearing each in front a lengthened, well-arched, cutting blade (*a*). The tongue is moderately broad, generally of an amber colour, occasionally dark: the posterior portion is tubular, and protrudes a little behind the buccal organ. In *P. quadrilineata* there are fifteen rows of plates, with twelve plates in a row,—six on each side. Two on each side, next the median line, bear bicuspid spines; the innermost of these have the spines considerably smaller than the others: the external plates are of an elongated form, a little elevated in the centre, and diminish in size towards the external border. The tongue is divided down the centre by a naked space, the central plate being wanting. In the other two species, the lingual organ is similar to the above, but in them the spines are shorter and stouter, and the innermost are proportionally smaller. In *P. ocellata*, the rows of plates are sixteen in number, with seven in a row on each side: in *P. Lessonii* there are only thirteen rows, eight plates on each side, and the naked space down the centre of the tongue is of considerable width.

The œsophagus (fig. 9*c*) is a rather long, simple tube, and has at its origin on either side a small salivary gland, (*b*) which opens into the buccal organ (*a*): these glands are tubular and are more or less folliculated. The œsophagus, passing backwards, enters the anterior border of the liver on its way to the stomach, which is small, and is buried in that viscus, the upper wall (*d*) being visible at the surface above and towards the left side. Here the intestine (*e*) leaves the gastric pouch, and passing across the liver to the right, arrives at the anal termination (*f*) in the midst of the branchial circle. The intestinal tube is rather short, and in



## POLYCERA.

*P. Lessonii* is a little dilated just before it terminates. A small oval sac, apparently the same as the pancreatic organ in *Doris*, opens into the stomach near to the œsophagus in *P. ocellata*: a similar organ probably exists in the other species, but has escaped observation. The liver (*g*) is of a brownish yellow colour, of an oval form, with the anterior extremity truncated; its secretion passes into the stomach through three or four openings.

The reproductive apparatus in *P. quadrilineata* is much like that of *Idalia*. The testis is divided into three portions; that (*i'*) next the intromittent organ (*h*) is moderately thick and tubular: the inner extremity of this portion is swelled a little, and is succeeded by an attenuated tube (*i''*) having a duct-like appearance, which leads to one end of a large, irregularly oval, glandular organ (*i*), presenting the semblance of a laminated structure; the other extremity of this portion is united by a short tube (*i'''*) to the oviduct. The ovary is spread out as usual over the liver, and the oviduct is at first slender, (*j*) and afterwards much dilated (*j'*) as it reaches the testis. The vaginal tube (*l*) is rather long and slender; it opens into the obtuse end of a very large pyriform spermatheca (*m*). A long, delicate duct (*n*), passes from the same point to the oviduct, and has attached to it a small oval sac—a second spermatheca (*o*). The mucus-gland (*k*) is much convoluted.

The generative organs, in *P. ocellata* and *P. Lessonii* are similar to those of *P. quadrilineata*, differing only in unimportant modifications. In the former, the glandular portion of the testis is smaller and fusiform, as in *Goniodoris*, and the principal spermatheca is roundish and much diminished in size.

The vascular system is apparently as highly developed in *Polycera* as in any of the *Dorididae*. The heart is contained within a pericardium, and is composed of a ventricle (*p*) and an auricle; the latter receiving the blood from the gills and skin, the former distributing it again by a large artery from the anterior apex in the usual manner. The portal heart lies below the pericardium, and is rather small. In *P. quadrilineata* there is a folliculated glandular organ in connexion with the arterial system, lying on the right side in front of the reproductive organs. This is similar to what has been observed in *Idalia* and *Ancula*, and will probably be found in all the *Polycerinae*. The heart beats sixty-two times in a minute in *P. Lessonii*; in *P. ocellata*, from seventy-two to eighty-eight times; and in *P. quadrilineata* from ninety to a hundred times.

The renal organ is distinctly visible in *P. Lessonii*, and is copiously supplied with vessels; the margins have a dendritic appearance, and the external orifice is placed to the right in front of the anus. In the other species this organ has been less perfectly observed.

The nervous system is provided with three pairs of œsophageal ganglia, besides the accessory ones. They may all be considered as placed above the alimentary tube, though the pedials droop a little on its sides. In *P. quadrilineata*, the cerebroids (fig. 12, *a, a*) are irregularly quadrilateral, inclined to pyriform, with the broad ends united across the median line. They give off from the frontal margin three pairs of nerves, (2, 3, 4), which go to the lips, the oral appendages, and channel of the mouth. The olfactory nerves (1) pass from the upper surface of the anterior margin, and have each at their origin a small round ganglion, and another (*j*), which is considerably larger, is connected with them as they reach the laminated portion of the tentacles: from the latter, several nerves pass up the tentacles. The branchial ganglia (*b, b*) are round, and closely adherent to the posterior extremity of the cerebroids: they give off each two nerves, one (7) of which goes to the skin of the back, and

## POLYCERA.

the other (6), passing forward, supplies the same in front, and also the tentacular filaments. The right branchial gives off from the under surface an additional nerve in connexion with the branchial collar, which shortly enlarges into a small round ganglion—the visceral (*e*): this sends two or three nerves (17, 18) to the viscera. The left branchial ganglion also gives off in connexion with the collar another visceral nerve (16). The pedial ganglia (*c, c*) are of an oval form, and are placed at the outer margins of the branchial, to which, and to the cerebroid, they are attached by very short commissures. They each give three nerves (9, 10, 11) to the foot, and the left ganglion a small one (8) to the side of the body. A similar nerve has not been observed on the right side, though it probably exists. These ganglia are united below the œsophagus by a long collar or commissure, (*i*) which is composed of two filaments. The branchial are likewise united below the alimentary tube; the cord (*h*), which is fine, leaving the ganglia in connexion with the origin of the visceral nerves. These two commissures run across in union with each other, forming, as it were, but one great œsophageal collar.

The buccal ganglia (*f*) are of an oval form; they are united across the median line by a distinct commissure, and to the cerebroids by long, slender cords (*g, g*). These ganglia give nerves in the usual way to the buccal organ, tongue, and œsophagus. The gastro-œsophageal ganglia have been observed only in *P. ocellata*.

*P. Lessonii* and *P. ocellata* exhibit no material modification in the nervous system: the cerebroids, however, are more rounded in the latter; and in the former are broad in front and pointed backwards, approximating in form to those of *Doris tuberculata*. The right branchial, too, of both species gives off a nerve in front, which goes to the male generative organ. There can be little doubt of the existence of a similar nerve in *P. quadrilineata*, but it has hitherto escaped observation. The visceral ganglion has not been noticed in *P. Lessonii*.

The eyes are rather large, and are as completely organised as in *Doris*; in *P. quadrilineata* they are each supplied with a short optic nerve (5) arising from a minute elliptical ganglion appended to the outer margin of the cerebroids. The auditory capsules contain numerous otolithes, and are attached to the under side of the outer margin of the same ganglia immediately behind the eyes. These have been examined only in *P. Lessonii*.

Vibratile cilia cover the whole surface of the body, including the tubercles, as well as the tentacles, gills, and branchial processes.

The skin is comparatively thin and delicate, having a few soft tubercles on the surface. The imbedded spicula are rather sparingly scattered; they are stout, linear, and generally tuberculated, and bent a little in the centre.





A. H. del.

C. Hullmandel's Patent Lithogr.

POLYCERA OCELLATA.

## Fam. 1, Plate 23.

### POLYCERA OCELLATA, ALDER and HANCOCK.

*P. viridi-nigricans*, maculis magnis, tubercularibus, luteo-albidis: tentaculis elongatis, ad basin tumidis, laminis 7-8: velo parvo, multi-lobato: appendicibus branchiarum lobato-ramosis, albidis.

*Polycera ocellata*, Ald. and Hanc. in Ann. Nat. Hist. v. 9, p. 33.

*Triopa Nothus*? Johns. in Ann. Nat. Hist. v. 1, p. 124.

*Hab.* Under stones in pools between tide-marks. Cullercoats and Whitley. Torbay. Dredged in Dublin Bay.

*Body* varying from three eighths to three quarters of an inch in length, linear-oblong, a little contracted behind the head and tapering to a point posteriorly; of a greenish black, arising from a very dense, minute black freckling on a yellowish ground, and covered with large spots of a pale yellow or reddish fawn-colour, the latter from the viscera appearing through. These spots are tubercular, wide at the base and sharp pointed: they are capable of extension and depression. *Dorsal tentacles* rather long, broad and conical at the base, and smooth for about two thirds up, above which they are laminated with seven or eight, sometimes nine, plates; the apex considerably produced and truncated; the whole is of the same colour as the body, with the sides of the laminæ darker, the edges and tip yellowish. The eyes, which are not easily distinguished on account of the dark colour of the skin, are placed a little way behind these organs. *Head* rounded in front, the sides of the mouth fleshy, slightly produced and obtusely angular. *Veil* short, interrupted in front, and continued round the sides of the head, with numerous yellowish white tubercular points; these are extended along the sides of the body in a tuberculated ridge, contracting towards the centre of the back and expanding again near the branchiæ, which they almost surround, terminating on each side with a tuberculated, sub-ramose branchial lobe. *Branchial plumes* five, rather large and imperfectly tripinnate: the three anterior plumes nearly of equal size, the posterior much shorter, arising from the base of the lateral ones; their colour is the same as that of the body, but not so dark; the margins pale and sometimes stained with fawn-colour. *Foot* yellowish, freckled with obscure green and stained with fawn-colour in the centre from the liver appearing through; truncated and rather squared in front, with the sides slightly produced; rather abruptly tapering to a point behind.

This species very closely resembles *P. Lessonii*, nevertheless, after many careful observations of both in a living state, we feel convinced of their distinctness. The tubercles are larger, fewer, and less permanent in form, but when produced they are more pointed than in *P. Lessonii*; those that surround the dorsal area are also generally whitish, while in the latter species they are of a deep yellow and more obtuse. But the principal difference is in the tentacles which in *P. ocellata* are longer, thicker, and more conical in the shaft, have fewer laminæ, and are more produced at the apex than in *P. Lessonii*. The branchial plumes too are larger and the branchial lobes more slender and less numerous.

## POLYCERA OCELLATA.

These, with the difference in colour, constitute the chief distinctive characters, but there is also observable some little difference in their habitats. On the Northumberland coast, where it is not very rare, we have never found this species but within tide-marks; *P. Lessonii*, on the contrary, is generally found in deep water on the same coast, and is common upon corallines brought in by the fishing boats; but never, among the many specimens which we have obtained by this means, have we found a single individual of *P. ocellata*.

At Torquay we found this species in pools among the rocks near high-water mark.

A curious light-coloured variety was brought to us among the produce of a day's dredging in Dublin Bay, where it appeared to occur in tolerable abundance: we did not learn at what depth, but from the other contents of the dredge we conclude that it was in shallow water. This variety had the dark portion of the surface much reduced in size, and forming little more than a network round the spots. Another variety occurs on the Northumberland coast; it is of a pale yellowish green entirely devoid of spots, and might easily be confounded with the young of *P. Lessonii*, but for the tentacles and branchial plumes, which are always sufficient to distinguish the species.

The *Triopa Nothus* of Dr. Johnston is most likely the young of this species; but, from the imperfect state of the specimen from which it was described, it would be impossible to speak with certainty.

This animal floats frequently, and can fix itself by its tail with great firmness to any substance over which it may be passing. It is sometimes difficult to detach it from the polished surface of glass. Its heart beats from seventy-two to eighty-eight times in a minute. Calcareous spicula are distributed through the skin, but are not crowded nor placed in regular order. There are two kinds, one much larger than the other: the larger is cylindrical, obtuse at the ends, a little bent in the centre and pretty regularly covered with irregular circles of tubercular points; the other kind is scarcely one third the size, smooth, cylindrical, slightly bent in the centre and thickened and rounded at the ends.

The spawn occurs in July and August—occasionally in September; and is generally of a delicate rose colour and of a strap form, attached by its edge to stones: it is usually two or three times coiled, sometimes not so much, with the coils rather wide apart and angulated. The eggs are of an oval form, and mostly in transverse rows.

Fig. 1, 2, 3. *Polycera ocellata*, different views.

4. A branchial plume, very highly magnified.

5, 6. Side and front views of a tentacle, much magnified.

7. A portion of the skin, showing imbedded spicula.

8, 9. Spicula, more highly magnified.

10. Spawn.

11. A portion of the same more highly magnified.





A. Hancock del. H. Holmes lithogr.

C. Hulmandel's Patern.

POLYCERA LESSONA



## Fam. 1, Plate 24.

### POLYCERA LESSONII, D'ORBIGNY.

*P. virescens*, vel luteola, corrugata, tuberculis luteis: tentaculis sub-clavatis, obtusis, 12-13 laminatis: velo parvo, multi-lobato: appendicibus branchiarum tubercularibus, sub ramosis luteis.

*Polycera Lessonii*, D'Orb., in Mag. de Zool. v. 7, p. 5, pl. 105.

*Polycera citrina*, Alder, in Ann. Nat. Hist. v. 6, p. 340, pl. 9, f. 7-9 (young).

*Polycera modesta*, Lovén, Index Moll. Scand. p. 6.

*Doris illuminata*, Gould, Invert. Massach. p. 4 (?).

*Hab.* Common on corallines from ten to twenty fathoms water, and rarely at low-water mark, Cullercoats. Dublin Bay, sparingly, *J. A.*

*Body* about half an inch, and occasionally three quarters of an inch long, ovate oblong, a little contracted behind the head, swelling in the centre, and tapering to a point posteriorly: of a yellowish-green colour, when adult,—pale lemon yellow in its younger state,—covered with blunt yellow tubercles of different sizes, generally arranged in indistinct lines. The skin is strongly wrinkled, and when examined with a magnifier the greenish colour is seen to be chiefly communicated by a sprinkling of dark green dots on a yellowish ground. *Dorsal tentacles* clavate, rather short, stout, and much rounded in the laminated part: laminae twelve or thirteen, close and compact. Eyes very minute, scarcely visible in old individuals. *Veil* margined with numerous tubercular points, interrupted in front, and expanded along the sides of the head, forming an arch round the tentacles, behind which a line of tubercles is continued along each side of the back to the branchiae, where it is again expanded and produced into a cluster of from two to five obtuse, ovate branchial lobes, of a bright lemon yellow: behind these is a central tuberculated ridge extending to the tail. *Branchiae* composed of three rather small, doubly pinnate plumes, of the same colour as the body, but paler. From the base of the two lateral ones large branches spring, which might perhaps be considered as two additional plumes. *Head* transversely elliptical, with the sides fleshy, and produced into obtuse points. *Foot* pale yellowish-green, with a darker border, and a patch of reddish-brown from the liver appearing through the centre; the whole surface minutely freckled with darkish green. It is squared, transversely slit, and a little produced laterally in front, behind which the sides are parallel, tapering posteriorly to a bluntish point.

The spicula are similar to those of *P. ocellata*, but rather stouter in proportion to their length. The heart beats sixty-two times in a minute.

This is one of the commonest Nudibranchs from deep water on the Northumberland coast, inhabiting the region of Corallines, and almost exclusively found on *Gemellaria loriculata*, which appears to be its favorite food. This zoophyte is brought in abundantly by the fishermen at Cullercoats adhering to their lines, and, by examining it carefully, individuals

## POLYCERA LESSONII.

of *Polycera Lessonii* may frequently be found lying like small drops of green jelly among its flaccid branches. When out of the water, they show very little form or appearance of life, and may readily be overlooked. Specimens have been met with, though rarely, on the rocks at low-water mark. It is not an active animal, and when kept in a glass, may be seen suspended by a film of mucous matter from the surface of the water for hours together. It also frequently hangs in the water by its tail, which it spreads out on the surface as a float.

The characters which distinguish this species from *P. ocellata* have already been noticed when treating of the latter.

The range of *Polycera Lessonii* appears to be extensive: M. D'Orbigny discovered it on the coast of France, near Rochelle; Professor Lovén finds it in Sweden; and what appears to be a variety of this species, has been found by Dr. Gould at Boston, in North America.

- Figs. 1, 2, 3. *Polycera Lessonii*, three views.  
4, 5. Tentacles.  
6. Branchial plume.  
7. A portion of the skin containing spicula.  
8. Spicula more highly magnified.





A. Hancock del A. Holmes lithogr

C. Bullmondell's Patern

MIRANDA CRISTATA

## Fam. 1, Plate 25.

### ANCULA CRISTATA, ALDER, *Sp.*\*

*A. alba*, pellucida, processibus flavo-terminatis: tentaculis clavatis, utrinque filamentibus 2 basalibus: branchiis 3, plumosis; appendicibus linearibus, 5-utrinque, cinctis.

*Polycera cristata*, Alder in Ann. Nat. Hist. v. 6, p. 340, t. 9, f. 10, 11, 12.

*Ancula cristata*, Lovén, Ind. Moll. Scand. p. 5.

*Hab.* Under stones between tide-marks. Cullercoats, Whitley, and Newbiggin; not uncommon. Holy Island, *Dr. Johnston*. Marsden, Durham, *A. H.* Dublin Bay and Malahide. Torbay; rare, *J. A.* Woodside, Cheshire; plentiful, *J. Price, Esq.*

*Body* about half an inch long, of a transparent watery white, smooth. *Dorsal tentacles* rather large, clavate, with eight or ten broad yellow laminæ on the upper half, above which the shaft is produced and truncated: at the base of each there are two linear appendages about half the length of the tentacle, and branching off from it nearly at right angles; they are white, with the ends bright orange or golden yellow. The portion of the body on which the tentacles are placed slopes gradually down to the subvelar lip, which is semicircular, and produced at the sides into two flattish tentacular processes, rather short but capable of extension, rounded at the ends, and usually tipped with orange. *Branchial plumes* three, placed on an elevated part near the centre of the back, and of a delicate transparent white, tipped with yellow, and having a double row of opaque white spots within the stem and principal branches. The plumes are nearly of equal length, and gracefully curved inwards. Immediately surrounding the branchiæ are ten linear and rather stout appendages, a little dilated at the base; they are set, five on each side, on a slightly elevated inconspicuous ridge, and have the upper portion of a bright yellow or orange. The hinder part of the body tapers gradually to a fine point; it is slightly keeled, and sometimes marked with a central orange line. The liver appears, through the transparent skin, of a brownish-yellow colour, and the ovaries which surround it and ramify over its surface are often very apparent. *Foot* linear, narrow, and rounded at the sides in front.

The usual colour of the processes in this elegant and graceful little creature is a golden yellow, but it varies in different individuals from a deep orange, through all the shades of yellow, to an opaque white. The number of branchial appendages is also apt to vary, but seldom exceeds ten, though an individual found by our friend Dr. Johnson, at Holy Island, which we have no hesitation in referring to this species, had as many as fourteen. We consider ten to be the normal number, the usual variation being a deficiency from imperfect

\* Called *Miranda cristata* on the Plate.

## ANCULA CRISTATA.

development. The skin, though quite smooth and transparent to the naked eye, is found, when examined under a microscope, to contain minute, crystalline, calcareous spicula, not much crowded, and arranged without apparent order. They vary in size, and are cylindrical, with the ends enlarged and rounded; they are generally bent in the centre, but in this respect there is considerable variation, some being arched or nearly straight, whilst others are bent acutely in an irregular manner.

This species was first described in the 'Annals of Natural History' under the name of *Polycera cristata*, when the characters in which it differed from the typical *Polyceræ* were pointed out, and the propriety of establishing for it a separate genus suggested. It approaches very nearly to *Idalia*, to which at one time we were inclined to unite it, but a further knowledge of that genus convinced us that the present species ought to form a genus distinct from either. We had consequently determined to raise it to that rank under the name of *Miranda*, when fortunately we learnt by a letter from Professor Lovén, of Stockholm, that he had already established for it the genus *Ancula*, in his 'Index Molluscorum Scandinaviæ.' This name, therefore, we now adopt, and are glad that the information came in time to prevent our adding to the list of useless synonyms. It is interesting to know that our species has been found on the coast of Sweden.

The spawn is deposited on the under sides of stones in pools, chiefly in July, August, and September, but not unfrequently as early as May or June, and occasionally as late as November. The ova are imbedded without much regularity in a rather wide, transparent, gelatinous belt, attached by one of its edges, and forming a single irregular coil.

This species is found among the rocks near Cullercoats all the year round, but is most abundant during the height of the breeding season, and is perhaps nearly as plentiful as any of the nudibranchs on the Northumberland coast. When removed from the water it has the appearance of an irregular globule, and might readily be mistaken for an unorganized mass of gelatine; but when again submerged the parts expand, and its true nature is at once revealed. It moves very gracefully, but without much rapidity, and when confined in a glass of sea water frequently swims on the surface.

The heart pulsates from seventy-two to seventy-five times in a minute.

- Figs. 1, 2, 3. *Ancula cristata* in different positions.  
4. Enlarged view of a branchial plume.  
5, 6. Different views of a dorsal tentacle.  
7. Much enlarged representation of spicula.  
8. A portion of the skin, showing the arrangement of the spicula.  
9. Spawn.  
10. A portion of the same, exhibiting the arrangement of the eggs.

## GENUS 7. ANCULA,\* LOVÉN.

*Corpus* elongatum, gracile, læve, non palliatum. *Caput* terminale, subinferius, utrinque in papillam brevem tentaculiformem productum. *Tentacula dorsalia* 2, subclavata, laminata, non-retractilia, basi stylis instructa. *Branchiæ* plumosæ, in lineâ mediâ dorsi anum circumdantes; cirris linearibus, subclavatis, utrinque ornatae. Apertura genitalis ad latus dextrum.

Like others of the *Polycerinae*, this genus is founded on a single species, and we may therefore refer to the account of that species itself for some part of its history. *Ancula* was established by Professor Lovén in his excellent little 'Index Molluscorum Scandinaviæ,' published in 1846. The species was first described by one of the authors of this work in 1841.† We have recently learned, however, that this beautiful little mollusk had been discovered by Dr. Fleming so long ago as 1814, having ascertained from a sketch kindly sent us by that distinguished naturalist, that the animal referred to in his 'British Animals,' page 283, is no other than the *Ancula cristata*.

The genus differs from *Polycera* in having basal filaments to the tentacles, and in the absence of a velar expansion and dorsal area. These latter circumstances likewise separate it from *Idalia*, with which, in most of its characters, it very nearly agrees; though its general habit, and more slender and graceful form, serve at first sight to distinguish it. The single representative of this genus appears to be generally diffused throughout the seas of Northern Europe, and is plentiful on many parts of the British coast. We have not heard of its occurrence in more southern latitudes. It is probably carnivorous, as it is never found on seaweeds, but is most plentiful on stones, associated with minute zoophytes.

*Ancula* has the body elongated, slender, and smooth, terminating in a point behind. There is no indication of a cloak, with the exception of a slight ridge in the vicinity of the gills, on which the branchial appendages are placed. The head is terminal, and without veil, having its sides produced into two short tentacular processes. The mouth is not provided with corneous jaws, but has a spinous prehensile collar. There are two subclavate, strongly laminated dorsal tentacles, without sheaths and non-retractile; near the base they are each furnished with two styliform appendages. The branchiæ are plumose, placed round the vent, on the most elevated part of the back, on the central line; they are surrounded by numerous linear or subclavate processes. The foot is slender and nearly linear. The common aperture of the genital organs is placed pretty far forward on the right side.

Any description of the anatomy of so minute and delicate an animal as *Ancula* must necessarily be imperfect; we have, however, possessed the advantage of having had at our command a large supply of specimens, and being thus fortunate, we have succeeded in

\* *Ancula*, a maid servant.

† Ann. Nat. Hist., v. 6, p. 340.

## ANCULA.

determining most points of importance, and in ascertaining that the internal structure bears out its relationship to *Idalia* on the one hand, and to *Polycera* on the other.

The oral channel is very short; it opens externally on the inferior surface of the head, and leads to a buccal organ, which is well developed, compact, and muscular, though of no great size; and has connected with its upper surface a gizzard, constructed in the same manner as in *Idalia* and *Goniodoris*. The tongue is long and narrow, having from twenty-five to twenty-seven rows of spines; there are four spines in each row, those next the median line being large, excessively broad, and flat, with their inner margins denticulated; the external spines are much smaller and plain; there is no central spine. The posterior portion of the tongue is tubular, and protrudes a little from behind the buccal organ in a sheath. The buccal lip is provided with a very formidable, spinous prehensile collar, (Pl. 17, fig. 7), which is wide, and, narrowing upwards, terminates on each side of the median line in a sharpish point. The spines, (fig. 8) are arranged in indistinct transverse rows; they are simple, curved, and much larger than is usual in the Nudibranchs.

The œsophagus is very long and slender: it has on each side, as it passes from the buccal organ, a small, oval, salivary gland, which pours its secretion into the mouth through a very short duct. At its origin, the œsophagus is swelled out into a crop, with delicate walls; it then suddenly contracts, and in the form of a constricted tube, passes through the nervous ring; immediately afterwards it again dilates a little for a short distance backwards, and contracting once more, is continued as a simple tube to the anterior border of the liver, into which it plunges on its way to the stomach. This latter viscus is small, and is buried just within the frontal margin of the hepatic organ. The intestine is given off from its upper surface, and, passing up through the liver, crosses over to the right side in front of the heart, and, after a short course, terminates in the anal nipple, within the branchial circle. There is a glandular enlargement of the intestinal tube just after it emerges from the liver, which is apparently the same as that which has been designated a rudimentary pancreas in *Doris*. The liver, of a yellowish brown colour, is rounded behind and truncated in front, and passes backwards beyond the branchiæ; the anus being situated comparatively further forward than usual.

The reproductive organs resemble, in the arrangement of their parts, those of *Goniodoris*, and the other *Polycerinae*. The three component parts of the testis are not very distinctly marked; the glandular or fusiform portion exceeding the tubular only a little in caliber. The vaginal tube and spermathecæ are small.

A delicate pericardium contains a ventricle and an auricle, and below it is the portal heart. The ventricle gives off in front, in the usual manner, a large artery, which branches to the various organs; and there is a folliculated glandular body, overlying the genitalia, which is apparently connected with the arterial system, and is probably similar to that described in *Doris*, as situated in the vicinity of the œsophageal ganglia.

The branchial leaflets exhibit, in a high state of development, that curious internal structure, which in *Doris* we consider as an elastic apparatus to aid respiration by keeping the gills, to some extent, in a state of expansion when out of water; and such an apparatus would seem of peculiar advantage to *Ancula cristata*, as it lives between tide-marks, and is liable to be left dry by the receding tide. In this species, the apparatus in question is formed of a double row of roundish vesicles, set on a central stem, and is situated in the trunk and prin-



## ANCULA.

cial branches of the leaflet, appearing in these parts as a double row of white dots. The walls of the vesicles are firm, and undoubtedly possess some degree of resiliency.

The œsophageal ganglia are not so much concentrated as in *Idalia*, in this respect agreeing with *Polycera*. In *Ancula* there are six principal ganglia, in three pairs. The cerebroids are placed above the alimentary tube, and are broadly fusiform, with their apices united across the median line. These supply nerves to the channel of the mouth, the lips, and dorsal tentacles; the channel and labial nerves are three in number; the olfactory or tentacular have each a small round ganglion at the origin, and from the root of these latter nerves there is also a minute twig given off, which goes apparently to the tentacular filaments at the base of the dorsal tentacles. The branchial ganglia are spherical, and are cemented to the under side of the cerebroids; they are placed at the sides of the œsophagus, and give off each a large nerve from behind, which supplies the dorsal skin. The right branchial also supplies, from the anterior margin, a nerve which goes to the root of the penis, and there joins a minute ganglion from which three or four small twigs are given to the intromittent organ. The pedial ganglia are situated below the alimentary tube, and are of the size and form of the branchial; they are closely united to the other two pairs above, and to each other below; thus completing a constricted collar of ganglia round that tube; they send three or four nerves to the foot. A small visceral ganglion is attached to the right branchial, at its junction with the pedial. Two or three nerves issue from it, which will, there can be no doubt, go to the viscera; but, from the minuteness of the species, we have failed to trace them. A delicate cord likewise passes from this ganglion, and, going to the branchial of the opposite side, forms the branchial collar.

There is nothing peculiar in the buccal ganglia, except that the commissure which unites them across the median line is rather long. The gastro-œsophageal ganglia have not been observed.

The eyes have the usual development; they are seated each on a minute round ganglion, which is sessile on the outer margin of the cerebroids. The auditory capsules contain numerous otolithes, but we have not succeeded in determining to which ganglia they belong.

Vibratile cilia appear to clothe the whole surface of the animal; they have been detected along the margin of the foot, and ridge of the back, on the gills and lateral papillæ, on the dorsal and oral tentacles, and on the tentacular processes.

The skin is smooth, soft, and delicate, with scattered imbedded spicula of a cylindrical form, bent in the centre and a little enlarged at the ends.







## Fam. 1, Plate 26.

### IDALIA ASPERSA, ALDER and HANCOCK.

*I. flavida*, fulvo et brunneo aspersa: appendicibus tentacularibus longis, ad basin utrique tentaculi 2, filamentis linearibus utrinque dorsi 4; branchiis 12, parvis, stellatis.

*Hab.* On a dead shell of *Fusus antiquus* from the fishing boats, Cullercoats.

*Body* half an inch long, thick, broadly elliptical, rounded in front, and abruptly tapering to a point behind; of a yellowish hue, blotched and spotted above with reddish brown and orange, which dies out towards the margin of the foot. The sides are sprinkled with opake white. *Tentacles* two, placed upon the back a little less than one third of the length of the animal from the anterior end; long, tapering, nearly linear, and much inclined backwards; of a fawn colour, freckled with brown and white. They are delicately laminated behind from the top almost to the base; the front is smooth. At the base of the tentacles, and nearly of the same length and thickness with them, are four linear, tapering, tentacular filaments, one in front and another at the side of each tentacle. These appendages rest upon a slight ridge, which is continued round the front of the tentacles and along the sides of the back past the branchiæ, terminating behind them. Upon this ridge, and about half way from the tentacles, arise on each side four small linear filaments, the posterior ones longest and situated at the sides of the branchiæ. *Branchiæ* consisting of 12 short, stiff, simply pinnate plumes with a broad mid rib, forming a complete circle round the vent, and non-retractile. They are of a pale fawn colour, speckled with a darker shade of the same, and with a large white patch near their apices. Behind these the back slopes rather abruptly down towards the tail. *Head* broad and obtuse, slightly lobed, but not produced, at the sides. The mouth is inferior; the margins of the lips as they pass off to the sides are thickened in a peculiar manner, forming an arch at each side. *Foot* broad, rounded and slightly arched in front, straightish at the sides, and abruptly brought to a sharp point behind. It is nearly colourless, the liver appearing through of a reddish salmon-colour.

A single specimen of this interesting addition to our fauna was obtained at Cullercoats in October, 1844. It did not possess much activity, but, while moving about, its tentacular filaments were kept perpetually in action. They waved with considerable grace, generally from above downwards, and then, just tipping the ground, were flung up again as if to ascertain the approach of danger. These might therefore be considered the true tentacles, did not uniformity of nomenclature oblige us thus to designate the lamellated organs generally considered so by naturalists. We have elsewhere endeavoured to show that the latter perform a different function, yet perhaps not incompatible with their being also employed as organs of touch.

In consequence of the position of the tentacles behind the cerebral ganglions, the eyes in this species appear before the tentacles, and not in their usual position, behind them.

## IDALIA ASPERSA.

The little animal spawned while in confinement. The spawn is of a rosy hue, and has the character of that of a *Doris*. It is about twice coiled, and forms a moderately deep, elegant cup, a little more than a quarter of an inch wide. The ova are small, numerous, and much crowded. We have twice before met with the same spawn on corallines from deep water brought in by the fishing boats. At Newbiggin it occurred in June. Our individual spawned in October.

The shape of this *Idalia* varies much at different times. Sometimes it draws itself up into a conical form; at other times it spreads itself out into a flattish disc; but usually the back is much elevated, especially towards the oval area formed by the slight ridge which includes the tentacles in front and the branchiæ behind. Under the microscope cilia were detected on the branchiæ and tentacles, but nowhere else. The skin was observed to contain spicula of a peculiar character. They are rather stout, pointed at the ends, and bent in the centre where there is a circle of largish nodules; there are also a few more imperfect circles of small nodules towards the ends. The spicula are not numerous, and are placed without any apparent order.

The species of *Idalia* approaching most nearly to this are, *I. lacunosa* of Philippi, and *I. (Doris) quadricornis* of Montagu, but both of these have only two tentacular appendages. *I. cirrigera*, Phil. appears to have four, but it differs from this species in many respects.

- Fig. 1, 2, 3. *Idalia aspersa*, different views.  
4, 5. Front and side of a branchial plume.  
6, 7. Back and front view of a dorsal tentacle.  
8. Spicula.  
9. Spawn.  
10. A portion of the same more highly magnified.

## GENUS 8. IDALIA,\* LEUCKART.

*Corpus* ovatum, crassum, anticè declive, posticè acuminatum, vix palliatum. *Caput* subinferius, subincrassatum, non tentaculatum. *Tentacula* 2 dorsalia, linearia, lamellata, non-retractilia. Area dorsalis cirris marginata. *Branchiæ* plumosæ, in lineâ mediâ dorsi anum cingentes. Apertura genitalis ad latus dextrum.

*Idalia* is a well-marked genus, characterised by Leuckart in 1828, in a small publication entitled 'Breves Animalium quorundam maxima ex parte marinorum Descriptiones.'†

The genus is distinguished from *Triopa* and *Euplocamus*, with which Dr. Philippi has confounded it, by its less distinct cloak, which forms a small dorsal area, not extending beyond the tentacles in front, and leaving a considerable space between it and the frontal margin of the head: the tentacles too are without sheaths, and the filaments which adorn the pallial margin are generally very long in front of them. These characters likewise distinguish it from the other allied genera.

The prevailing colour in *Idalia* is red. Its range appears to be pretty extensive, and, though nowhere common, members of the genus are found in most of the European seas. They chiefly live in deep water, and hence, perhaps, the infrequency of their occurrence. They are carnivorous.

The body in this genus is ovate, thick, and a good deal elevated on the central area of the back, from which it slopes down on all sides, especially in the frontal region, which is large and incrassated. The head is indistinct, broad, and subinferior, with a slight expanded margin above. There are no oral tentacles. The two dorsal tentacles are generally slender and linear: they are laminated,—sometimes only slightly and on the posterior side. The base of each is adorned with one or two filaments, which have sometimes been taken for additional tentacles. These are not attached to the tentacles themselves, as in *Ancula*, but to a thin and rather inconspicuous membrane—the margin of the rudimentary cloak—that circumscribes the dorsal area, passing close to the base of the tentacles in front, and running along each side of the back to the branchiæ. This margin is more or less fringed with filaments; the inclosed area has also frequently one or more rows of filaments. The branchiæ are plumose, and surround the vent on the posterior dorsal line: behind these a ridge runs down to the tail. The foot is broad, thick, and rounded in front. The aperture of the generative system is on the right side.

*Idalia* may be divided into two sections, differing from each other in the armature of the mouth, as well as in the following external character.

Section 1. Centre of the back with filaments. Type, *I. elegans*.

Section 2. Centre of the back without filaments. Type, *I. aspersa*.

Our observations on the internal organisation of this genus will have to be confined to that of *I. Leachii*, as this is the only species we have had the advantage of dissecting, and we are not aware that any description of the anatomy of the other forms has been published. We have, however, examined the lingual apparatus of four or five kinds.

\* A name of Venus, from Mount Idalium, in the Isle of Cyprus, sacred to that goddess.

† We are indebted, for a copy of this publication, to Dr. Rüppell, of Frankfort.

## IDALIA.

\* From the external characters, it is evident that *Idalia* and *Goniodoris* are closely related to each other; but the intimacy of their connexion is only made manifest by the study of their anatomy.

The mouth of *Idalia* opens almost at once into a buccal organ, which is rather small, and is provided with a muscular gizzard attached to the upper surface, and a pair of short tubular, salivary glands, with their extremities enlarged and folliculated. The tongue of *I. Leachii* is narrow, of a brown-amber colour, and formed of numerous rows of spines, four in each row; those next the centre being large and minutely denticulated at the sides; the external ones are simple and rudimentary: there is no central spine. The buccal lip is armed with a prehensile collar, not interrupted above, and having the surface covered with numerous minute simple spines.

In *Idalia elegans* the large lingual spines are similar in form to those of *I. Leachii*, but have the sides smooth. In *I. aspersa* and *I. pulchella*, belonging to the second section, these spines are broader, stouter, and more hooked, with the margins strongly denticulated; and moreover the prehensile collar (fig. 5 a), in these two latter species, is very imperfect, being composed of two rounded, minutely-spinous lobes, one on each side of the median line on the lower portion of the buccal lip.

The œsophagus is a long slender tube without dilatation: it opens from below into the stomach, which is small, and placed in a cleft in the anterior margin of the liver. The intestine proceeds from above, and passes backwards along the right side of the liver: towards its termination it is considerably enlarged. The liver is bulky and of an irregular oval form.

The reproductive apparatus differs only very slightly from that of *Goniodoris*. The testis is composed of three portions, but here the gland-like part cannot be called fusiform, but is irregular in shape and very large. The vaginal tube, though not so long as in *Goniodoris nodosa*, is very wide, and tapers as it approaches the spermathecæ, of which there are two; one being much larger than the other: both are elliptical. The ovary is spread over the upper surface of the liver, and the anterior surface of the oviduct is much dilated.

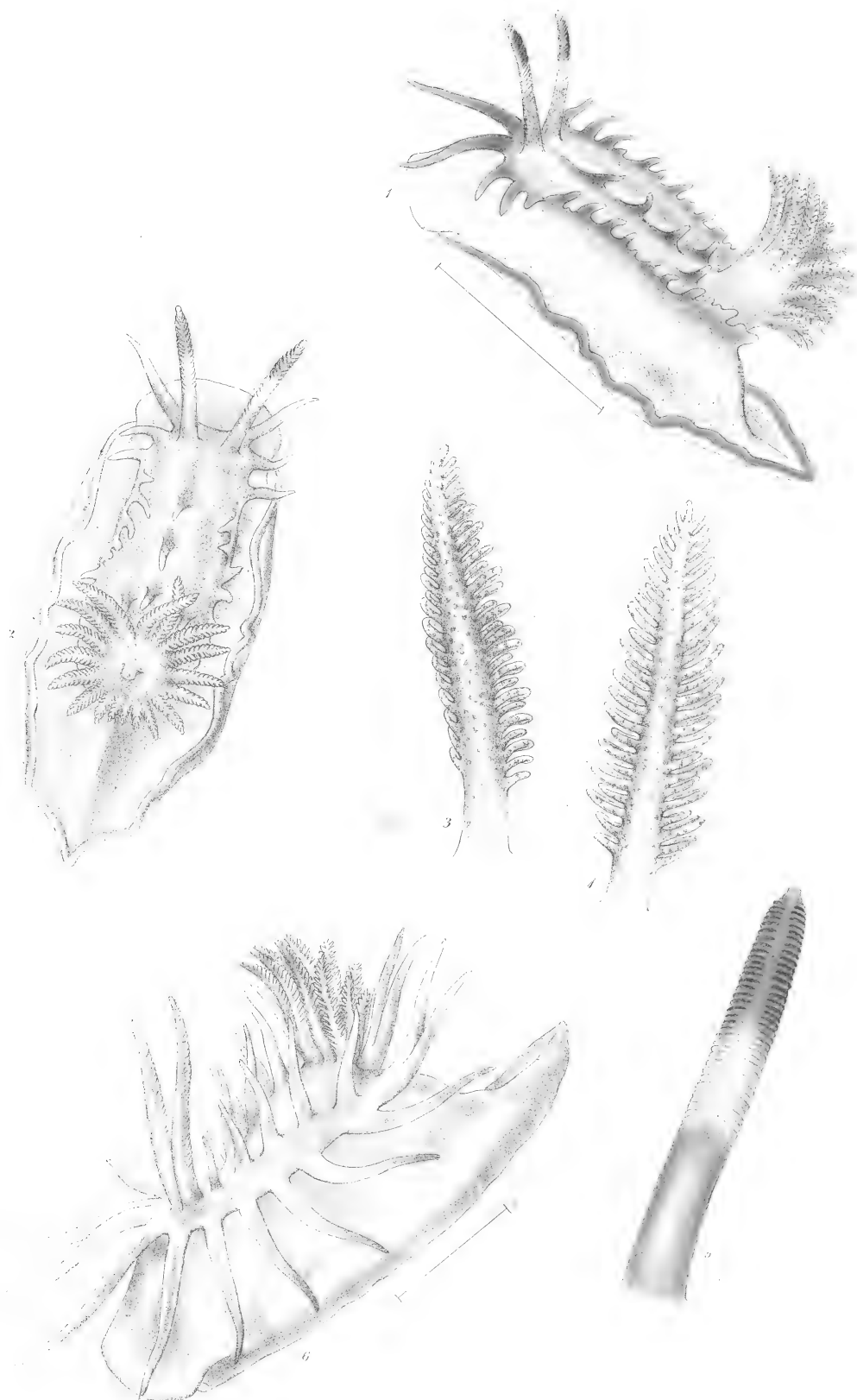
The auricle and ventricle are placed within a distinct pericardium, below which is the portal heart; and in every respect the circulation and respiration are exactly in the same condition as in *Goniodoris*. The renal organ has been only imperfectly observed, but the external orifice is conspicuous enough in front and a little to the right of the anal nipple. A glandular organ of a folliculated structure is in connexion with the arterial system in front of the generative apparatus.

The nervous system presents the same high degree of concentration observed in *Goniodoris*; there being four principal œsophageal ganglia; but the upper pair in *Idalia* are bilobed, indicating the position of the cerebroid and branchial, of which they are composed. The eyes are sessile on the outer margin of the cerebroids; the auditory capsules have not been observed, neither have the olfactory ganglia. The nerves are distributed much in the same manner as in *Goniodoris*.

The skin is smooth and soft, with imbedded spicula, which, in *I. aspersa*, are not crowded; they are fusiform, tuberculated, and bent in the centre. Cilia were detected on the tentacles and branchiæ, but nowhere else.







## Fam. 1, Plate 27.

*Figs. 1 to 4.*

### IDALIA ELEGANS, LEUCKART.

*I. rosea*, maculata; filamentibus margine palliali numerosis, aurantiacis apicibus flavis, posticis brevibus lobatis, anticis 2 elongatis, filamentibus dorsalibus 5; branchiis 18 elongatis; pede magno, luteo marginato.

*Idalia elegans*, Leuck., Breves Anim. Desc., p. 15, f. 2.

*laciniosa*, Phil., Enum. Moll. Sic., v. 2, p. 77, pl. 19, f. 5.

*Hab.* Dredged in fifteen fathoms, St. Peter's Port, Guernsey, *J. A.*

*Body* an inch and a half long, rather stout and elevated on the dorsal area, pale rose-coloured, freckled with darker spots of the same colour. *Tentacles* rather long, linear, minutely laminated on the upper portion for about two-thirds down: the base of each tentacle is rose-coloured, above which it is white spotted with red; the upper part is deep rose-coloured to nearly the apex, which is bright yellow. The pallial ridge is much expanded, and forms a more distinct cloak than we have met with in any other species of the genus; it has two long, rather stout and tapering filaments in front,—one near the base of each tentacle: the lateral filaments are numerous; two or three of the anterior ones are of moderate length, the rest short and rather irregular, becoming broad, obtuse and lobated at the sides of the branchiæ; they are all of a brilliant orange colour with yellow tips. There are also five stout papillæ on the back,—three down the central line, and two sublateral in front of the branchiæ; they are freckled with rose-colour below, and yellow above. *Branchial plumes* eighteen, the anterior and posterior ones bifid, for nearly their whole length, rather large, simply pinnate, arising from an elevated base, and diminishing gradually from front to back, forming a complete circle: they are rose-coloured, spotted with a darker shade of the same colour, and become bright yellow towards the apices: the general base is pale. *Head* broad and thick, sloping gradually down from the tentacles, and having a slight velar expansion over the mouth: its colour is white, with a minute freckling of pink above, and a yellowish tinge towards the edge. *Foot* very large, spreading and undulating at the margin, which is usually turned a little upwards: it is white with a freckling of rose-colour towards the upper part, and down the posterior ridge to the tail. The margin has a border of bright orange with a yellow edge: the underside is white, with a darker shade in the centre from the liver: the front angles are rounded, and the posterior extremity rather obtusely pointed.

We can scarcely doubt that this is the *Idalia laciniosa* of Phillippi; the specimen from

## IDALIA ELEGANS.

which his description was taken, however, was not half the size of ours, and appears to have been less brightly coloured; the branchial plumes were also proportionally smaller, which may have arisen from its being a young individual. We think that we likewise recognise in our animal the true *Idalia elegans* of Leuckart; although his description, having been taken from a dead specimen, is deficient in some of the points necessary for comparison. The characters agree in every thing as far as they go. The number of branchial plumes is greater in this than in any other species of the genus. Leuckart makes them, 18-20,' and according to our own observation the real number is eighteen, though from two of them being bifid, they exhibit twenty points. One or two of the posterior ones are very inconspicuous, and may readily be overlooked.

Well indeed does this *Idalia* merit the name of *elegans*! It is certainly the most beautiful of the tribe we have met with. The orange of the filaments is so brilliant as to defy the power of the painter, and the delicate rose-colour of the body, in the individual from which our drawing was taken, added much to its attractions. A second specimen had the colours a little darker.

This valuable addition to our Fauna was dredged in the summer of 1853, near Castle Cornet, in Guernsey. From a curious habit, hitherto unknown in this tribe, of concealing itself in the test of an Ascidian (*Cynthia tuberosa*), it escaped observation on being taken from the dredge, and was put into our collecting-box as an *Actinia* partially expanded. On examining the contents of the box in the evening, we were delighted to find we had got a beautiful *Idalia*, which had crept so far out of its place of concealment as to display its true form. A second individual was afterwards found amongst the contents of the box, with only its head and anterior filaments protruded from the test of another *Cynthia* of the same species. This was put into a glass of sea-water over night untouched, to allow it to creep out without injury: but in the morning it was found inhabiting the same cavity, from which it had not made any attempt to escape, and it required a gentle pressure of the Ascidian to disengage it. From our desire to get a drawing of the Nudibranch in a fresh state, we neglected to examine the Ascidian more carefully, in order to ascertain the nature of the connexion between them. The cavity from which it emerged appeared to be similar to those made by the *Modiola marmorata*, which is frequently lodged in the test of this *Cynthia*, and the *Idalia* may therefore have entered it to prey upon the mussel; but it is a curious circumstance that both the specimens taken should have been so lodged, and with the head outwards; seemingly indicating a habit of remaining concealed in such a situation, which the reluctance to quit it also seemed to imply.

Figs. 1, 2. Side and back views of *Idalia elegans*.

3. Two brachial plumes, much enlarged.

4. Front view of tentacle.

## Fam. 1, Plate 27.

Fig. 5.

### IDALIA LEACHII, ALDER and HANCOCK.

*I. alba*; tentaculis gracilibus; margine palliali filamentibus perlongis, anticis 4, lateribus utrinque 6, instructo; filamentibus dorsalibus numerosis, ordinibus 3 vel 5; branchiis 11, pinnatis, inæqualibus.

*Idalia elegans*, "Leuck," Alder, in Trans. Tynes. Club., p. 112.

*Hab.* Torbay, Mrs. Griffiths, (Mus. Leach). Whitburn, Durham, Rev. G. Cooper Abbes. Hebrides, G. Barlee, Esq.

*Body* about an inch long, convex, white tinged with rose-colour from the viscera shining through. *Tentacles* linear, tapering, long and slender, finely laminated posteriorly nearly to their base; with four filaments in front, two near the base of each tentacle, set on the pallial margin, which passes close in front of the tentacles, and circumscribes a small area on the back. Lateral filaments six on each side, long and slender, the last bifid; attached to the pallial ridge. There are numerous filaments on the back; the central row containing three, and the two sublateral rows three or four filaments each: there are occasionally two additional rows developed posteriorly, containing one or two filaments each; making in all five rows. *Branchiæ* consisting of eleven slender pinnate plumes, largest in front and becoming small behind, where the circle is incomplete. The anterior plume is bifid for about two thirds the length: the two posterior plumes are also bifid. *Foot* broad and fleshy, tapering to an obtuse point posteriorly.

The spicula are large, linear-fusiform and more or less bent in the centre, around which they are strongly nodulous: one or two rings of small nodules occur also on other parts of the surface.

We described this species under the name of *Idalia elegans* in the Catalogue of the Mollusca of Northumberland and Durham, on the authority of a specimen so named in Dr. Leach's Collection in the British Museum, expressing, at the same time, a doubt of the correctness of the appellation. Further observation has convinced us that this is not the species of Leuckart; and having recently taken specimens of what we think to be the true *Idalia elegans*, we have given the name of *Leachii* to the animal now under consideration. It comes very near to the *I. cirrigera* of Phillippi, from which, however, it differs in the number of filaments and branchial plumes. Dr. Phillippi's figure also represents the dorsal area much broader than it is in our animal.

Four examples of this fine *Idalia* have occurred:—the British Museum specimen already mentioned, sent from Torbay by Mrs. Griffiths; a small individual, half an inch long, obtained by Mr. Abbes from the fishing-boats at Whitburn; and two specimens got by Mr. Barlee in one of his dredging excursions to the Hebrides, which are now, by his liberality, in our possession. The Whitburn specimen, the only one we have seen in a fresh state, and from which our figure is taken, was unfortunately dead when it reached us. The drawing is, consequently, less perfect than it might have been had we seen the species alive.









## Fam. 2, Plate 1.

### GENUS 9. TRITONIA,\* CUVIER.

*Corpus* oblongum, quadrilaterale, postice acuminatum, subpalliatum. *Caput* inferius, velo fimbriato vel mucronato obtectum; maxillis corneis. *Tentacula* 2 dorsalia, cylindrica, suprâ ramosa vel filamentosa, intra vaginas retractilia. *Branchiæ* pectinatæ vel plumosæ, ad marginem pallialem serie unicâ utrinque dispositæ; interdum in limbum fimbriatum conjunctæ. Aperturæ ani et generationis ad latus dextrum.

The genus *Tritonia*, well known through the Memoir of Cuvier, was one of the earliest established by that distinguished naturalist from the dismemberment of the *Dorides* of the Linnean school. It has now become the type of a family. The species contained in it do not appear to be numerous, but are widely distributed through the seas of our globe. Four only are natives of Britain; the typical *Tritonia Hombergii* being the largest of our indigenous Nudibranchs.

*Spherostoma* of Macgillivray is synonymous with this genus. It was established on a specimen of *Tritonia Hombergii* in which the buccal mass had been extruded by the animal when dying; a circumstance occasionally observed in the Mollusca of this order, and giving the creature a peculiar appearance, not unlikely to deceive any one unacquainted with this singular habit.

The body of *Tritonia* is elongated and somewhat quadrilateral, from the elevation of the sides and the prominence of the ridge formed by the pallial expansion: it is broad in front and acuminate behind. The head is sub-inferior and indistinct, and is covered by a fimbriated or mucronated veil. The mouth is large and furnished with powerful corneous jaws, and a broad denticulated tongue. There are two tentacles which are dorsal, cylindrical and solid below, but divided above into numerous filaments, generally more or less pectinated or branched: they are retractile within sheaths, with plain margins or nearly so. The branchiæ consist of branched or laminated tufts, set in single series down each side of the back, on a prominent ridge or margin, formed by the rudimentary cloak, which is observable in this genus: these are sometimes united by intermediate filaments into a continuous expansion extending to the tail, where it terminates in a point. The back is generally more or less tuberculated. The anal aperture is lateral, situated on the right side of the animal; that of the genital organs is at a short distance in front of and below it on the same side.

The individuals of this genus are carnivorous. They are very inactive and sluggish in habit, though not by any means wanting in beauty, the branchial plume-like tufts redeeming their otherwise heavy contour.

\* A name of Minerva.

## TRITONIA.

A pretty full account of the anatomy of *Tritonia*, is given in the 'Memoires des Mollusques' of Cuvier; but, requiring more complete details, we have thought it desirable to re-investigate the entire subject, and have in consequence carefully dissected *T. Hombergii*, the anatomy of which we purpose giving at considerable length; *Tritonia* being the type of our second family.

The oral opening is placed on the inferior surface of the head, and is guarded by a wrinkled lip, which is divided by a fissure into two lateral lobes. The channel leading from thence into the buccal organ is very short. The buccal organ itself (fig. 2*a*, and f. 3) is of vast magnitude, exceeding in this respect that of all other Nudibranchs. It is very muscular, somewhat depressed, of an irregular quadrate form, and provided with powerful corneous jaws, which extend the whole length of the organ, imbedded in the muscles. The jaws (figs. 7, 8) are much elongated, rather narrow, with the anterior extremities arched upwards, and firmly united by an elastic cartilage. The inner margins are thick, forming serrated cutting blades (figs. 7*b*, 8*b*).

Three sets of muscles are employed in the movement of the jaws; one of which (fig. 4*d*, and fig. 3*e*) passes across in front of the cutting blades above, and another (4*d'* and 3*e'*) below, having the oral opening between them; their extremities are inserted into the external surface of the jaws towards their outer margin. These two sets, acting in unison, will bring the cutting blades together, whilst the elasticity of the hinge, aided by the third set (4*e* and 3*f*) will separate them. This last-named set lies transversely over the hinge, and is attached by its two extremities to the jaws; thus it will not only assist in closing them, but also in binding them together. A very similar arrangement of muscles for moving the jaws exists in *Eolis*. The buccal mass and jaws in *T. alba* and *T. plebeia*, are like those of *T. Hombergii*, but in both the former the cutting blades are furnished with a peculiar denticulated belt (fig. 10*c*, and fig. 11*b*) on the outer surface. It is likely that in these instances the jaws are principally prehensile organs, holding the prey by the aid of the denticulated belt, while the tongue is employed in tearing off piece by piece, and so transporting it to the œsophagus. A similar belt has been observed in the young of *T. Hombergii*, but not satisfactorily in the mature animal.

The tongue of *T. Hombergii* is very large, filling up the greater part of the buccal cavity, and is so placed that the anterior or upper portion of the dentigerous membrane (fig. 4*f*) is opposed to the œsophagus. This membrane (fig. 5) is formed on the plan of that of *Doris tuberculata*, being broad and tubular, with the anterior portion (*a*) expanded somewhat like the mouth of a trumpet. The expanded portion only, which forms, as it were, two lateral lips, is brought to act upon the food; and the lingual pouch does not extend backwards beyond the buccal mass. The operative part is divided by a fleshy process from that which is more distinctly tubular, and within which the spines are developed.

The dentigerous membrane in *T. Hombergii*, when removed from the lingual muscles and spread out, is broader than long; and the teeth or spines (fig. 6) are long, simple, and very numerous. They are arranged in eighty-four transverse rows, each containing four hundred and forty spines, and a central (*b*) and two lateral plates (*c*, *c*). The central plate is rather large and of a quadrate form, with three not very distinct, obtuse denticles. The lateral plates are irregularly oval, each bearing a blunt projection. In *T. alba* the membrane is considerably longer than broad, and is supplied with twenty-nine rows of about seventy-two spines each, together with a central and two lateral plates. The spines are long, arched, and denticulated: the central plate has three stout denticles; the lateral plates bear an elevated

## TRITONIA.

ridge on their outer margin. The membrane of *T. plebeia* is broader than in *T. alba*, but not by any means so broad as in *T. Hombergii*. In it there are thirty-two rows of simple spines with the points much and suddenly hooked: each row contains forty-two of these, and a central and two lateral plates like those of *T. alba*.

The muscular support of the dentigerous membrane is composed of two sets or layers of fibres,—an external and an internal layer; these move over each other freely, there being no union between their surfaces. The inner layer (fig. 4*h*) forms the walls of the cavity within which the posterior portion of the dentigerous membrane is placed; and being attached in front to a dense, semi-cartilaginous body, upon which the spiny membrane is expanded, and behind to the posterior part of the inner surface of the jaws, this layer will, when brought into action, draw together the sides of the tongue, bringing the spines to close upon the food. The outer layer is made up of three strata of fibres, by far the thickest of which (*i, i*) underlies the other two, and is formed of numerous transverse laminæ, arranged in regular parallel order. These laminæ or fibres act also upon the anterior semi-cartilaginous support, and have their opposite extremities attached to the inner surface of the jaws, immediately in front of the attachment of the inner layer. This stratum is for the purpose of rotating the tongue backwards, and upwards in the direction of the gullet, and will, with the aid of the inner layer, withdraw the whole organ. Immediately overlying this stratum is another (*j*) the fibres of which are most developed in front or below, and cross those of the under stratum. These fibres pass likewise from the semi-cartilaginous support, and go to the root of the tongue, and are apparently for the purpose of rotating the organ forward. The third or superficial stratum is very thin; its fibres are transverse, and have a tendency to compress the tongue, and perhaps in this way to elongate it.

The lingual muscles in *Doris* and *Eolis* are arranged much in the same manner, modified only to suit the altered condition of the parts. In *Doris tuberculata* the semi-cartilaginous support of the dentigerous membrane is developed to a much greater extent; and the inner and outer layers of muscles, which are not so distinctly marked, have both their extremities attached to it, and the muscular fibres move over it as cords over a pulley. The semi-cartilaginous support does not appear to exist in *Eolis*, and the muscles are no longer divided into inner and outer layers. But a powerful mass of fibres is provided for drawing the tongue back, which is attached by one end to the posterior extremity of the dentigerous membrane, and by the other to the jaws. The stratum of fibres, for rotating the tongue forward, appears to be represented in that genus by the muscles, which, forming the sides of the lingual mass in front, are attached by one end to the anterior portion of the spinous membrane, and, inclining backwards have their other extremity inserted into the jaw behind. By the interlacement of the fibres of these latter muscles, a dense mass is formed in the centre of the tongue, which gives support to the spiny ridge, and firmness to the whole organ, and acts as a sort of fulcrum about which the retractor muscles work.

The œsophagus (fig. 2*b*) in *T. Hombergii* is rather wide, of moderate length, and passes from the upper surface of the buccal mass further forward than usual. On each side of it a long, tubular, folliculated salivary gland (*c, c*) opens into the mouth. The stomach (*d*), of no great size, is irregular in form, and is partially concealed by the liver, the left lobe of which lies over it. The intestine (figs. 1 and 2*e*) is a short widish tube of equal diameter throughout; it passes from the upper aspect of the gastric organ, and advancing a little forwards, bends

## TRITONIA.

towards the right side in front of the heart: it then dips down and terminates in an anal nipple situated about midway along the side immediately below the mantle. The alimentary tube is longitudinally plicated throughout; in the stomach the plicæ are strong and much wrinkled.

The liver (*f*) is a large pyriform body with the obtuse end forward and hollowed for the reception of the posterior portion of the stomach. The left side is much prolonged, forming a lobe which advances a considerable way forward. The colour is a yellowish rose, caused chiefly perhaps by the ovary which envelopes the organ. The hepatic fluid enters the posterior end of the stomach by a single large duct.

The alimentary system varies only a little in *T. plebeia*, in which the œsophagus is dilated into an anterior stomach or crop; and the stomach itself is almost concealed by the liver, the anterior lobe of which is large and passes quite in front of it. The gastric organ has therefore the appearance of lying in a transverse cleft.

The reproductive organs seem to be arranged more on the plan of *Eolis* than of *Doris*. They are composed of the usual three parts,—male, female and androgynous, which open into a common vestibule having a single outlet on the right side of the body, about half way between the head and the anal nipple. The intromittent organ (fig. 2*k*), which is situated in front of the other parts, is long and tapering; and the testis (*l*), a convoluted tube of no great length, is connected with it by one extremity and by the other to the oviduct. The ovary is firmly attached to the liver over which it is spread. The oviduct, at first very delicate (*n*), dilates and forms a widish tube (*m*), a little convoluted. Before reaching the testis it contracts to its former diameter, and after its junction with that organ, it suddenly turns upon itself and sinks into the mucus-gland (*o, o*). This latter organ, like that of *Eolis*, is very bulky, and is formed of two lateral masses made up of convoluted tubes, which open into the female channel (*p*). The androgynous apparatus is very simple, being composed of a mere elongated, pyriform sac, or spermatheca (*q*) terminating a rather short vaginal tube (*r*). This tube opens as usual into the common vestibule above and between the male and female orifices. There is here no accessory spermatheca nor special duct leading from the androgynous parts to the oviduct as in *Doris*. The seminal fluid hoarded in the spermatheca must, therefore, pass again down the vaginal tube, and fertilise the ova as they pass out; or it must find its way by the same tube into the female organs; in which case it will penetrate the oviduct and perhaps reach even as far as the ovary.

The generative organs are a little modified in *T. plebeia*, in which the testis is composed of two portions; one thin and tubular, the other a little enlarged and fusiform. From the inner extremity of this latter portion, a constricted duct leads to the oviduct, the dilated part of which is very wide and doubled upon itself. The spermatheca is large and oval; the vaginal tube short and distinct.

The organs of circulation differ in some respects from those of other Nudibranchs. The heart as usual lies immediately below the dorsal skin, about half way down the body, and is enclosed within a delicate, transparent pericardium, which extends the whole width of the back (fig. 1, *j*). The ventricle (*k*) is strong and muscular, with the sides much produced, giving it externally very much the appearance of being composed of two chambers. The aorta passes from the frontal apex, and gives branches to the various organs. The auricle (*l*) is comparatively delicate; it is narrow, transversely elongated, reaching from side to side of

## TRITONIA.

the pericardium, and has the anterior margin produced into a lobe at each side; it lies, immediately behind the ventricle, and receives at each end a trunk vein ( $m, m$ ) from the skin. These trunk veins bifurcate within the skin, one branch ( $n$ ) passing forward, the other ( $n'$ ) backward close to the margin of the mantle, and drain the blood from the sinuses or cellular tissue of the skin, and from the gills; consequently returning to the heart a stream of imperfectly aerated blood. These trunks are therefore efferent branchial veins.

The systemic circulation is two-fold as in *Doris*,—general and partial. By the former all the blood sent to the various organs, except that which is distributed to the liver mass (comprising liver, ovary, and renal organ) must as usual reach the system of inter-visceral sinuses, and so find its way into the cellular tissue of the skin, and from thence to the heart by the lateral or efferent branchial veins just mentioned. By the partial or hepatic circulation, which is probably supplied with a complete set of capillaries, the blood which is transmitted to the liver mass, and that only, is conveyed to the branchiæ by six trunk veins ( $o, o, o$ ); three passing from each side of the organ. These trunks are formed by the convergence of numerous branches on the surface of the liver, and each on reaching the skin is divided into two portions ( $p, p$ ), one of which passes forward, the other backward: these run along within the skin, immediately below the efferent branchial veins, and give branches to the branchial plumes. It would seem, then, that the branchial circulation is probably as complete as in *Doris*, the blood being conveyed to and from the gills by a system of afferent and efferent vessels; but the latter, we have seen, are not distinct, for they carry to the heart also the blood from the skin, which here, as well as in the *Dorididæ* and *Eolididæ*, undoubtedly assists in aerating the blood.

The hepatic circulation has in connexion with it a portal circulation, evinced by the presence of a portal heart ( $q$ ), which lies as usual below the pericardium, a little to the right, and is related to it as in *Doris*. This heart is very large, being not much inferior in size to the systemic ventricle; it is of a cylindrical form, with the ends truncated, and the interior is strongly plicated longitudinally as in *Doris*.

The renal organ has not been examined, but its presence is proved by the renal orifice, which is situated close above the anal nipple. It is apparently connected with the liver as the great vessel from the portal heart enters that viscus.

The cerebral ganglia resemble those of *Eolis*. The œsophageal are all placed above the alimentary tube; of these there are apparently at first sight only two principal pairs,—the cerebroid (fig. 9  $a, a$ ) and branchial ( $b, b$ ) being fused so as to form two elongated masses, one on each side the median line, across which they are united by a short commissure. The component parts are, however, distinctly defined by a constriction near the centre of the masses. The olfactory nerves are given off from the upper surface of the anterior portion or cerebroid ganglia. They (1) are long, and, on reaching the dorsal tentacles, each swells out into a rather large roundish ganglion,—the olfactory ( $d$ ), from the upper aspect of which, numerous filaments pass up the tentacle. A small twig from each of these nerves apparently goes to the veil next the median line. Three pairs of large nerves (2, 3, 4) go from the anterior margin of the same ganglia and supply the veil; one of these (2) sends a large branch to the channel of the mouth; and another (4) gives a twig to the tentacular point below the veil. Two pairs of small nerves (5, 6) are given off apparently from the commissure, uniting the cerebroid and pedial ganglia; these go to the skin of the sides of the body. The

## TRITONIA.

posterior portions or branchial ganglia give off, from the upper surface behind, a pair of large nerves (8) which supply the dorsal skin; and the right branchial furnishes an additional single nerve (7) to the root of the male intromittent organ. This is the only one we have traced of the visceral nerves though doubtless others exist. The pedial ganglia (*c, c*) are round, and united by short commissures to the cerebroid and branchial. They give off three pairs of stout nerves (9, 10, 11), which are distributed to the foot. The great sub-œsophageal collar (*h*) is wide, and is composed of three filaments, two of which belong to the pedial ganglia,—one to the branchial.

The buccal ganglia (*f*) are situated as usual on the buccal organ, immediately behind the gullet; they are rather large, broadly elliptical, and united across the median line by a short commissure, and to the under side of the cerebroids by two long cords (*i, i*) forming the buccal collar. These ganglia give two pairs of nerves (12, 13) to the buccal organ, and a single one (14) to the tongue; the latter comes off from the commissure uniting the ganglia. They have also appended to them by much longer cords than usual, a pair of gastro-œsophageal ganglia (*g, g*); these supply, besides the œsophageal nerves (17) (the par vagum), two other pairs, one of which (15) goes to the salivary glands, the other (16) to the root of the œsophagus.

The senses are in the same condition as in *Doris*. The eye (*j*) is small, and is removed to a considerable distance from the cerebral ganglia. The optic nerve is consequently long; it is very delicate and arises from a small ganglionic enlargement (*e*) seated above and behind on the outer margin of the cerebroids. The auditory capsules have not been examined in *T. Hombergii*, but in *T. plebeia*, in which the cerebral ganglia are similar, they contain numerous otolithes (fig. 12 *e*), and are sessile on the under surface of the cerebroid ganglia, a little in advance of the commissures (*d*), which unite these ganglia to the pedial. Taste probably resides in the lips, touch everywhere, but is specialised in the tentacular points of the veil.

The skin is devoid of spicula, and is thick and coriaceous.

## EXPLANATION OF THE PLATE.

Fig. 1. General view of the viscera of *Tritonia Hombergii*, the dorsal skin laid open:—*a*, buccal organ; *b*, œsophagus; *c, c*, salivary glands; *d*, anterior portion of the stomach; *e*, intestine; *f*, liver enveloped in the ovary; *g, g*, portions of the mucus-gland in connexion with the female organs; *h*, retracted penis; *i*, portion of the testis; *j*, pericardium; *k*, ventricle, seen through the transparent wall of the pericardium; *l*, auricle; *m, m*, lateral venous trunks, or efferent branchial veins, passing from the skin to the auricle; *n, n'*, branches of the same laid open, showing orifices communicating with the gills and cellular tissue of the skin; *o, o, o*, afferent branchial veins from the liver-mass; *p, p*, branches of the same exposed, giving twigs to the branchial plumes; *q*, portal heart seen through the transparent walls of the pericardium; *r*, œsophageal ganglia, giving nerves to the various organs; *s, s*, the eyes.

2. General view of the viscera, the various organs partially separated:—*a*, buccal organ; *b*, œsophagus; *c, c*, salivary glands; *d*, stomach; *e, e*, intestine cut through; *f*, liver enveloped in the ovary; *g*, root of the aorta, the ventricle removed; *h*, anterior branch of the same; *i*,

## TRITONIA.

hepatic branch of the same; *j, j, j, j*, afferent branchial veins from the liver-mass; *k*, retracted penis; *l*, testis; *m*, dilated portion of the oviduct; *n*, constricted portion of the same; *o, o*, mucus-gland in connexion with the female parts; *p*, female channel; *q*, spermatheca; *r*, vagina, leading from the external orifice to the same; *s*, œsophageal ganglia, distributing nerves to the various organs; *t, t*, the eyes.

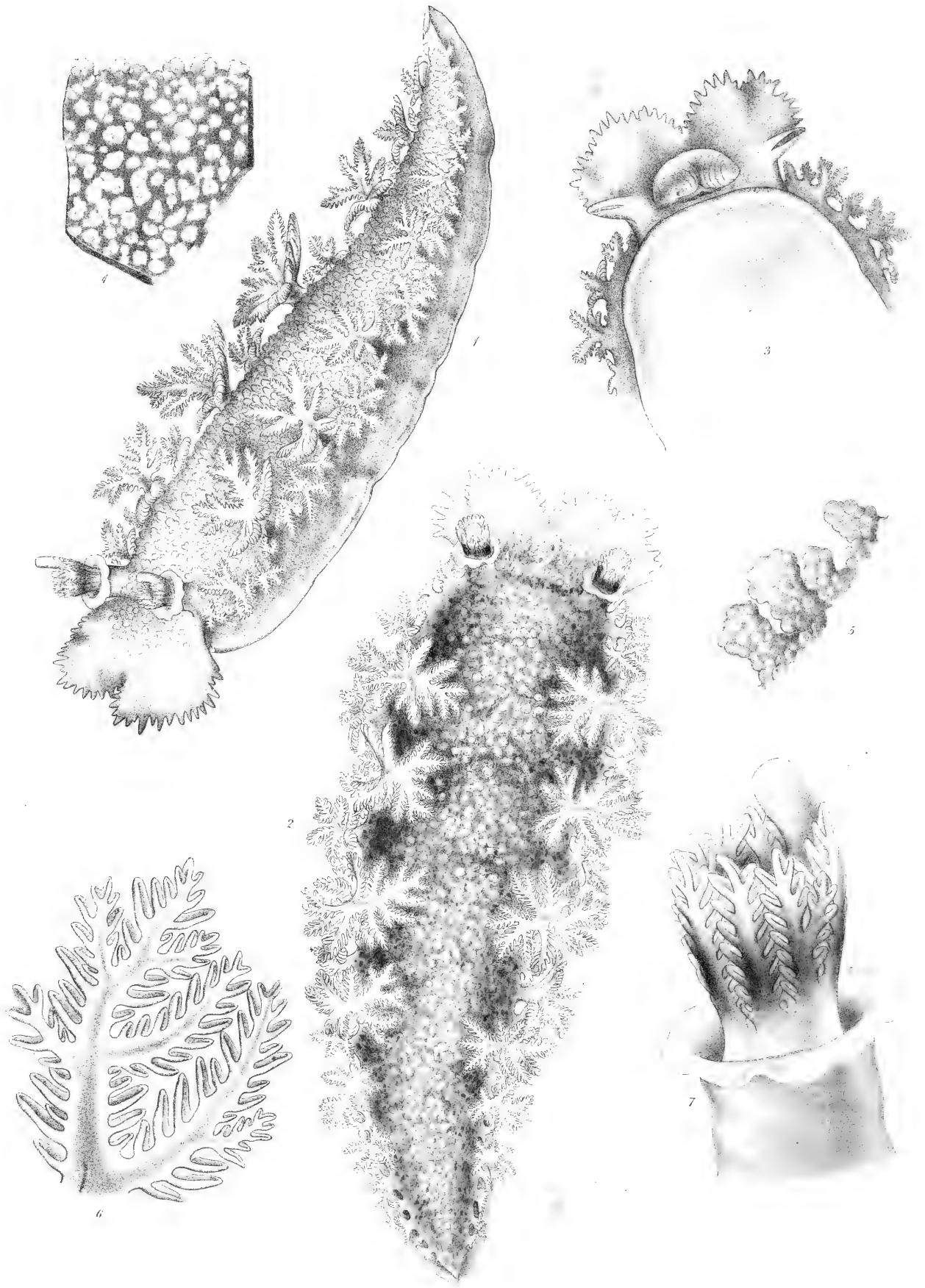
Fig. 3. Side view of the buccal mass:—*a*, channel of the mouth; *b*, œsophagus; *c*, salivary glands; *d*, outer edge of jaw; *e, e'*, two sets of muscles for closing the jaws; *f*, muscles to aid in opening the same; *g*, lingual muscles.

4. Side view of the buccal mass, with one jaw and part of the muscles removed to exhibit the tongue:—*a*, œsophagus; *b*, cutting edge of jaw; *c*, hinge cut through; *d, d'*, two sets of muscles for closing the jaws, cut through; *e*, muscles to aid in opening the same; *f*, anterior or expanded portion of the dentigerous membrane; *g*, end of the posterior or tubular portion of the same; *h*, portion of the inner layer of lingual muscles for drawing the sides of the tongue together; *i, i*, principal stratum of the outer layer of muscles for drawing the tongue upwards and backwards, the two outer strata being almost entirely removed; *j*, a portion of one of the outer strata of the same, for rotating the tongue forward, the outer or external one being removed.
5. Dentigerous membrane removed from its muscular support:—*a*, anterior or expanded portion of the membrane; *b*, posterior or tubular portion of the same.
6. A portion of one of the rows of lingual spines:—*a, a*, lateral spines; *b*, central plate; *c, c*, the two lateral plates.
7. Inside view of jaws:—*a*, hinge; *b*, cutting edges.
8. Outside view of a single jaw:—*a*, point of articulation; *b*, cutting edge.
9. Cerebral ganglia:—*a, a*, cerebroid ganglia; *b, b*, branchial; *c, c*, pedial; *d*, olfactory; *e*, optic; *f*, buccal; *g, g*, gastro-œsophageal; *h*, great sub-œsophageal collar; *i, i*, buccal collar; 1, olfactory nerves; 2, 3, 4, nerves of the veil, 2 sends a branch to the channel of the mouth and 4 one to the tentacular process on the under side of the veil; 5, 6, nerves to the skin on the sides of the body; 7, genital nerve; 8, pallial nerves; 9, 10, 11, pedial nerves; 12, 13, buccal nerves; 14, lingual nerve; 15, nerves to the salivary glands; 16, nerves to the root of the œsophagus; 17, œsophageal nerves.
10. Inside view of the jaw of *T. plebeia*:—*a*, point of articulation; *b*, cutting edge; *c*, denticulated belt.
11. A portion of the jaw of the same more highly magnified:—*a*, cutting edge; *b*, denticulated belt.
12. Under view of a portion of the œsophageal ganglia of the same:—*a*, cerebroid ganglion; *b*, branchial; *c*, pedial; *d*, commissures uniting the pedial to the cerebroid and branchial ganglia; *e*, auditory capsule.









## Fam. 2, Plate 2.

### TRITONIA HOMBERGII, CUVIER.

T. oblongo-ovata, subconvexa, fusca, purpurascens, vel carneo-albida; velo bilobato digitato-fimbriato; dorso tuberculato; branchiis numerosis, frondoso-plumosis, ad latera dorsi utrinque dispositis.

*Limace de Mer palmifère*, Diquem., Journ. de Phys. 1785, pl. 2. (sec. Cuv.)

*Doris frondosa*, Mull., Zool. Dan. Prod., p. 229?

Gmel., Syst. Nat., p. 3107.

*Tritonia Hombergii*, Cuv., Mem. du Mus. v. 1., p. 483, pl. 31, f. 1, 2.

Blainv., Man. de Malac., p. 487, pl. 46, f. 6.

Lam., Anim. s. Vert. 2d ed., v. 7, p. 454.

Bouch. Chant., Catal. des Moll. du Boul., p. 37.

Flem., Brit. Anim., p. 284.

Forbes, Mal. Mon., p. 3, pl. 1, f. 5.

Johns., in Ann. Nat. Hist. v. 1., p. 114, pl. 3, f. 1, 2.

Leach, Syn. Moll. Gr. Brit., p. 24, pl. 7, f. 2.

Dalyell, Pow. Creat., v. 2, p. 271, pl. 38, f. 1, 2.

*atrofusca*, Macg., Moll. Anim. Aberd., p. 346.

*Sphaerostoma Jamesonii*, Idem, p. 336.

*Hab.* In deep water, on all parts of our coast.

*Body* from three to six, and sometimes even eight inches long, oblong, rather depressed, subquadrilateral, rounded on the back, and tapering to a blunt point behind; varying in colour from dark purple-brown, to light brown, flesh-colour, and yellowish white. The back is covered with large, unequal, soft, warty tubercles, often much mamillated and sometimes slightly branched towards the posterior extremity of the body. *Veil* strongly bilobed, and margined with numerous small digitations, terminating on each side with a stout tentacular process visible only from the under side. *Tentacles* cylindrical below, rising above into a fasciculus of pectinated or branched filaments of equal size, with a stout, plain, truncated process appearing a little above them behind. They are retractile within rather wide sheaths, expanded and turned over at the top, with the margin irregularly scalloped or undulated. *Branchiæ* set along the sides of the back on a much undulated pallial expansion, and forming a continuous row of beautifully laminated plumes of unequal size. The larger ones, five or six in number, are placed at intervals, rise upwards, and turn over on the back: they consist of a short cylindrical pedicle, from which bipinnate branches spread over in a horizontal direction. The intermediate plumes are of the same character, but smaller, inclining outwards, and becoming rudimentary towards the posterior extremity, where they meet in a point very close to the tail. The sides of the body are a little elevated, concave, and smooth or very faintly tuberculated. *Foot* rather broad, transparent yellowish white; grooved and rounded in front, and produced into a blunt point behind.

## TRITONIA HOMBERGII.

This fine nudibranch—the giant of its tribe—is stated by Diquemare, to reach the length of eight inches; and Sir J. G. Dalyell has found it of similar size, but it is seldom met with of a greater length than six inches, and usually it does not exceed four. It is a deep-water species, very generally diffused, but seldom obtained except by the dredge or trawl; occasionally, however, it is brought in on the fishermen's lines. In its young state it is less plumose and warty than the adult form. The spawn is deposited in the form of a gelatinous yellowish-white cord, about the thickness of small whip-cord of great length and very much convoluted. The eggs are disposed in it about five or six abreast, without regular order. Sir John G. Dalyell gives a detailed account of the spawning of this animal, in the second volume of 'The Powers of the Creator displayed in the Creation,' page 275. In reading it, however, it will be necessary to bear in mind that the author confounds two species, and that the smaller masses of spawn figured probably belong to *Tritonia plebeia*.

Professor Edward Forbes mentions two varieties on the coast of the Isle of Man,—a purple and a yellowish variety,—the latter is generally longer than the former (often six inches long) and has the branchiæ smaller. The *Tritonia atrofusca* of Macgillivray was described from a very dark variety of this species, examined in a dead state. The specimen is in our possession, having been obligingly presented to us, along with his other Aberdeenshire *Nudibranchiata*, by Dr. Macgillivray. His genus *Sphærostoma* is also founded upon a specimen of *T. Hombergii*, in a bad state, as has been before mentioned.

*Tritonia Hombergii* is very sluggish in its movements, and is not easily kept in confinement. It discharges a great quantity of mucus. As might be inferred from its immense jaws, it is a very voracious animal. M. Bouchard Chantereaux states that its principal food is the *Alcyonium digitatum*, which is confirmed by the observations of Sir J. G. Dalyell. The former naturalist has also frequently found individuals between the valves of oysters, of which they had partially devoured the animal. We have taken from the digestive cavity of this animal large lumps of the tube of *Amphitrite ventilabrum*, with the *Alcyonium* adhering to it.

The range of *Tritonia Hombergii* is nearly co-extensive with the Atlantic shores of Europe, but it does not appear to reach into the Mediterranean.

Figs. 1, 2, Side and back views of *Tritonia Hombergii*.

- 3, Under side of the anterior portion of the same.
- 4, A portion of the cloak enlarged.
- 5, A few of the tubercles in profile.
- 6, A portion of a branchial plume.
- 7, A tentacle.





## Fam. 2, Plate 3.

### TRITONIA PLEBEIA, JOHNSTON.

*T. quadrata*, supra fusco et fulvo liturata, subtus alba: velo integro, 8-mucronato: branchiis 5-6 utrinque, parvis, bipinnatis.

*Tritonia plebeia*, Johns., in Edinb. New Ph. Journ. v. 5, p. 77.

Idem, in Ann. Nat. Hist. v. 1, p. 115, pl. 3, f. 3, 4.

*Tritonia pulchra*? Johns., in Edinb. New Ph. Journ. v. 5, p. 78.

*Hab.* On *Alcyonium digitatum* and other zoophytes from deep water; common. Berwick Bay, Dr. Johnston. Cullercoats and Newbiggin, Northumberland. Whitburn, Durham, Rev. G. C. Abbs. Aberdeen, Professor Macgillivray. Cork Harbour, Professor E. Forbes. Rothesay Bay. Torbay.

*Body* upwards of an inch in length, oblong, quadrilateral, with nearly parallel sides, truncated in front, and tapering to a point behind. Colour various, but generally of a pale yellowish brown on the back, with darker brown markings; sometimes reddish brown, greenish, or yellow, and frequently spotted with opaque white. The dark markings are strongest behind the tentacles, and generally form two irregular lines along the sides of the back, interrupted and paler opposite each pair of branchial tufts. *Oral veil* entire and nearly straight, sometimes very slightly notched in the centre; transparent white, occasionally veined with purple-brown, and produced into about eight tentacular points. *Tentacles* issuing from entire-edged cylindrical sheaths, columnar and transparent below, above rather opaque, generally yellowish, and surmounted by a fasciculus of branched filaments of nearly equal length, excepting one placed towards the back, which is simple, truncated, stouter than the rest, and extends beyond them. *Back* nearly flat, obscurely tuberculated, angulated at the sides, but not produced into a wavy pallial expansion. The sides of the head are also angulated. *Branchial tufts* five or six on each side, small, erect, bipinnate, frequently with a single lateral branch. The first and last tufts are small, the others larger, and in old individuals there are occasionally minute intermediate ones. Sides of the body nearly perpendicular, smooth, and more or less marbled or veined with purple-brown on the upper part. *Foot* transparent white, the centre having a yellowish tinge from the liver; it is rounded in front, and produced into a blunt point behind.

The heart beats 72 times in a minute.

This species, first noticed by Dr. Johnston, is distinguished from *T. Hombergii* by its more squared and less depressed form, by the obscure pallial ridge, and by the simpler form of the branchiæ, which in the young of the latter are more branched and obtuse, spreading out from a foot-stalk on all sides, whilst in this species they have a greater resemblance to those of the *Dorididæ*. The best character, however, is in the veil, which in *T. plebeia* is entire, with seldom above seven or eight points, while in *T. Hombergii* it is always bilobed and more produced, with numerous points.

## TRITONIA PLEBEIA.

Dr. Johnston now considers his *Tritonia pulchra* to be a variety of this, which is not improbable, considering how much the species varies in colour, though we have not seen a specimen entirely agreeing with his description. We have more than once met with a lemon-yellow variety, which may possibly be the *Doris electrica* of Pennant, his figure agreeing better with the form of this species than of any other we are acquainted with.

*Tritonia plebeia* is not by any means an active animal. It is very generally distributed in the British seas, and is one of the commonest deep-water nudibranchs of our eastern coast. Professor E. Forbes found it in the Ægean, but it has not yet been noticed on the western shores of Europe. Probably it may have been overlooked, from its similarity to the young of the larger species.

We have not often met with the spawn of this species. It is usually deposited on the stems of corallines, and forms an irregular waved or festooned mass, the spiral nature of which it is not easy to trace. When deposited on a flat surface, however, it assumes a regular waved spiral, as we had the opportunity of seeing in an individual that spawned on the side of a glass. The gelatinous thread is narrow and rounded, containing numerous eggs, arranged about five abreast throughout. This individual spawned in October, but we have also met with the spawn in May.

Figs. 1, 2, 3. *Tritonia plebeia*, in different positions.

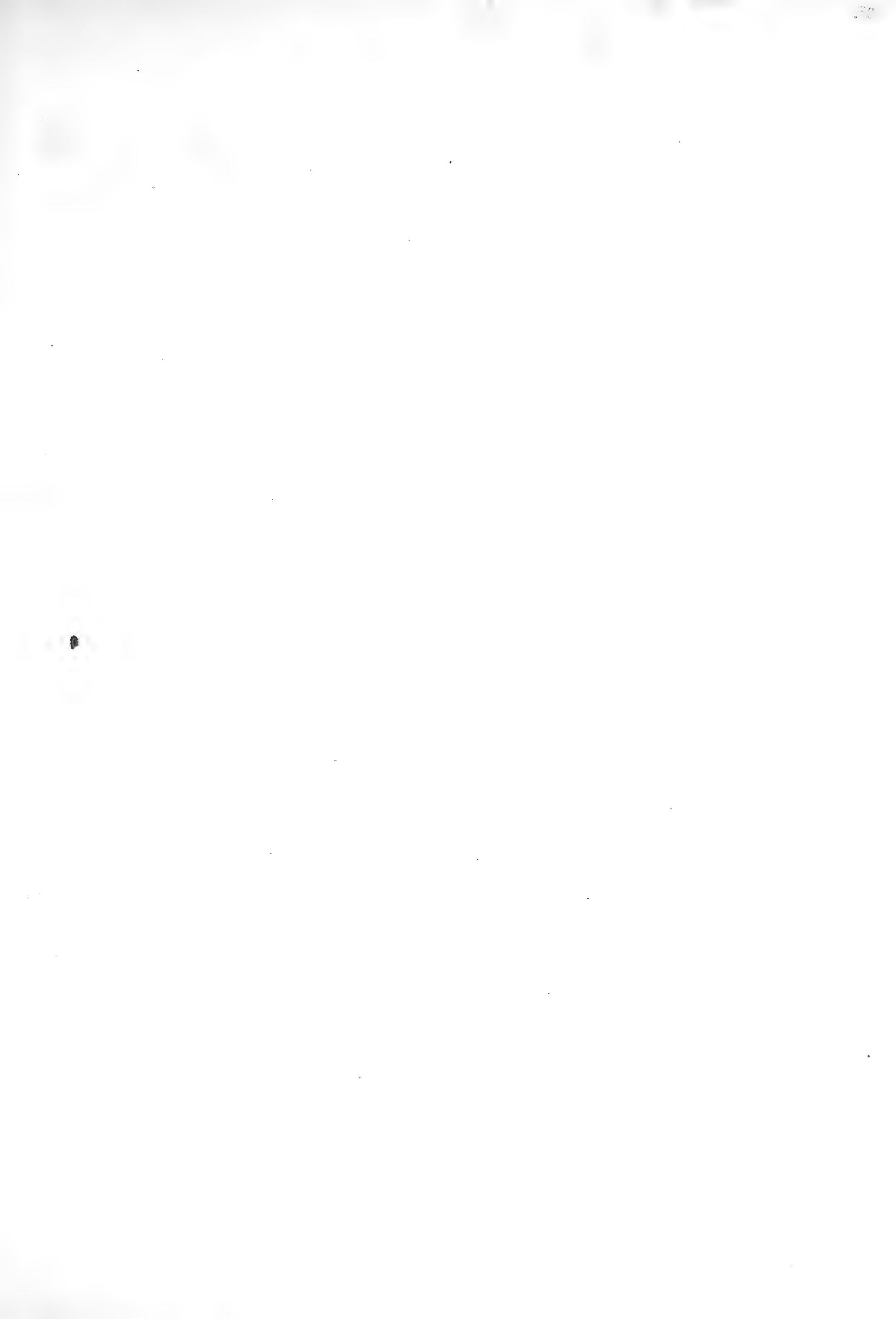
4. A branchial plume more highly magnified.

5. A tentacle very highly magnified.

6. Spawn.

7. A portion of the same highly magnified.





Adiantum del. C. W. Wright.

C. Holmboe, a forest landscape.

TRITONIA LINNÆA.



## Fam. 2, Plate 4.

### TRITONIA LINEATA, ALDER and HANCOCK.

*T. gracilis*, alba, pellucida; dorso lineâ albâ opacâ utrinque notato; velo processibus linearibus 4; branchiis parvis, pinnatis, utroque dorsi latere 5.

*Tritonia lineata*, Ald. and Hanc., in Ann. Nat. Hist., 2d ser., v. 1, p. 191.

*Hab.* Under stones between tide-marks, Scarborough, *J. A.*

*Body* five eighths of an inch long, very slender, linear, pellucid white, with an opaque white line along each side of the back; sides parallel. *Veil* rather narrow, produced in front into four long filaments, the two nearest the centre longest. They are pellucid, with opaque tips. *Tentacles* entire and colourless below, pale yellow above, and divided into several stems, with delicate and slender laminæ or branches. The principal stem, situated posteriorly, is thicker and longer than the rest, and truncated at the top. Sheaths rather long and tightish, expanding a little above; the margins undulating. The eyes are distinctly seen behind the tentacles. The *back* is very delicately, scarcely perceptibly, tuberculated, and from its transparency shows the viscera through of a pale yellowish or rosy hue. The two opaque white lines unite into a point above the head in front, diverging thence toward the tentacles, and are continued along the sides of the back, curving outwards opposite each pair of branchial tufts; they unite again posteriorly, and are continued in a central line to the tail. The pallial ridge is somewhat produced. *Branchiæ* rather slender, imperfectly bipinnate, transparent, white, with an opaque white line in the centre of each, running into those on the back: there are four or five pairs of branchial tufts, the posterior ones very small. *Head* scarcely distinct from the veil, the mouth opening inferiorly. *Foot* slender, rounded in front, and tapering to a point behind; the liver forming a reddish-yellow patch down the centre.

We obtained this delicate and graceful little *Tritonia*,—very distinct from anything before recorded,—under large flat stones among the rocks north of Scarborough, which we explored in September, 1846, in company with our friend Mr. Bean. Two specimens only were found, one by ourselves, and a second by that gentleman. They lived with us for some time, and deposited one or two patches of spawn. The eggs are imbedded in a narrow, transparent belt, rather closely coiled about four times.

Figs. 1, 2, 3. *Tritonia lineata*, different views.

4. A tentacle, more highly magnified

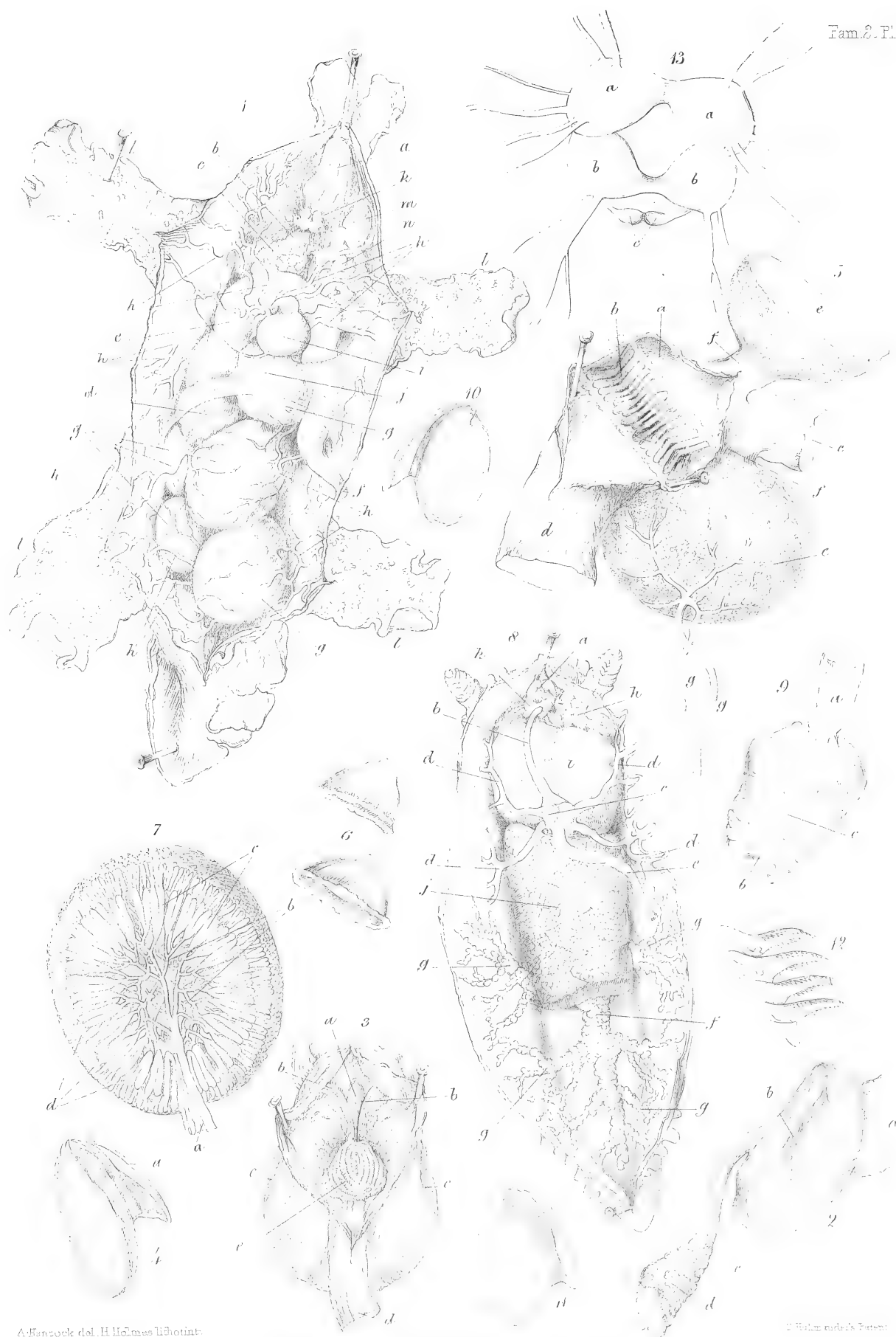
5. A branchial tuft.

6. Spawn (the coil is reversed by mistake).

7. A small portion of the same, showing the eggs.







## Fam. 2, Plate 5.

### Genus 9 bis. SCYLLÆA, LINNÆUS.

*Corpus* oblongum, lateribus valdè compressis, dorso convexo, lobis magnis, biparibus, utrinque cristato. *Caput* sub-inferius; maxillis corneis. *Tentacula* duo, anterioria, dorsalia, lamellata, intra vaginas magnas, cristatas, retractilia. *Branchiæ* parvæ, ramosæ, in lobarum dorsalium facie internâ sparsæ. *Pes* linearis. Orificia generationis et ani ad latus dextrum.

The genus *Scyllæa* was established by Linnæus, but was very imperfectly understood until the time of Cuvier, whose elaborate Memoir upon the genus first placed its characters and affinities in their true light, and left little to be added by succeeding writers. Cuvier gives some curious instances of the mistakes made by the early naturalists with respect to the animal on which this genus was formed. Seba, who was the first to publish it, took it for the young of a fish, and figuring it in an inverted position, placed it in the genus *Lophius*; and Linnæus himself, though he so far understood its affinities as to remove it to his class *Vermes*, and to create for it a new genus, described the animal upside down; a mistake which was followed by Gmelin, and copied by subsequent authors until near the time when Cuvier wrote his memoir. It was also supposed by some of the older naturalists, that the animal was permanently fixed to the sea-weed on which it was found; an idea originating in the firm hold which it takes of the stems of *Fuci*, to prevent its being dislodged by the force of the waves. All authors describe the foot as deeply grooved, but this view of its formation is only a remnant of the old errors. From a knowledge of other mollusks with similar habits, we have little hesitation in saying that the foot will be found perfectly flat when crawling on a level surface, but that, its sides being highly flexible, it is capable of grasping a cylindrical stem, as in other allied genera, with great ease and firmness.

This genus includes only one or two species, but is widely diffused through the seas of both hemispheres, to which its habit of living on floating sea-weeds mainly contributes. Its recognition as an inhabitant of the British seas is but of recent date, but as the number of observers increases, it will most likely be found more frequently on the Atlantic portion of our coast.

*Scyllæa* is not more remarkable for its curious external form, than interesting on account of its internal anatomy. In it is observed the first distinct partition of the liver mass, as well as an approach towards that branched form of the digestive organs so remarkable in the *Eolididæ*: for not only is the liver divided into globular masses, as represented by Cuvier, but from these masses ramifications proceed, which pass into the dorsal lobes, some of them even penetrating into the branchial tufts; a circumstance which has escaped the observation of that great naturalist. Taken in connection with *Dendronotus* and *Eumenis*, this genus well illustrates the series of modifications by which one form of organ is gradually changed

#### SCYLLÆA.

into another. Here, however, the typical character of the *Tritoniadæ* is still sufficiently preserved to allow of our retaining the genus in that family. This is the only nudibranchiate mollusk in which any armature of the stomach, performing the functions of a gizzard, has been detected.

The body of *Scyllæa* is elongated, very much compressed at the sides, and gibbous upon the back, sloping down to the anterior and posterior extremities. It has two tentacles, which are dorsal, but placed forwards nearly above the head. They are rather small, clavate, and laminated, and are retractile within large sheaths; these are wide near the top, tapering to a narrow base, and are stated to be very contractile: the orifice inclines forwards, and there is a thin, arched, crest-like appendage behind it. The head is sub-inferior; the mouth fleshy, without oral tentacles, and covered by a slight velar expansion of the frontal margin. The jaws are corneous. On each side of the back arise two or three erect flattened lobes of irregular form. On the inside of these, as well as on the median portion of the back, are placed the branchiæ, which consist of small tufts of delicately branched filaments, disposed in an irregular manner. The foot is linear and very narrow, with the sides thin and flexible, formed for clasping the stems of sea-weeds. The anus is situated on the right side between the first and second dorsal lobe, and nearly equally distant from the two extremities of the body. The orifice of the generative organs is placed lower down and more forward on the same side, being only a short distance behind the right tentacle.

On opening the animal from above, the buccal mass is seen to occupy the anterior extremity of the body. This organ is rather larger than usual, and is of an oblong ovate form, narrowest in front. It is furnished with horny, cutting jaws, resembling those of *Eolis*. The tongue, however, is formed after the type of *Tritonia*: its anterior portion is convex, and assumes a sub-conical form, with the apex turned upwards and forwards; posteriorly, it becomes concave, the concavity being directed towards the œsophagus, and having the appearance of a cylinder, capable of being turned inside out. The whole of this organ is covered with denticulated spines, rising over the projecting part, and entering into the cavity: they form about thirteen transverse rows, divided by a narrow groove down the centre, on which, in each row, is a broad plate containing a central tooth, with three or four denticulations on each side. The points of the spines are directed backwards and inwards, so that when the tongue is advanced, and the margins of the concavity separated, it will become a powerful prehensible apparatus, at once able to rasp down the food and carry it to the œsophagus.

The œsophagus is long and rather wide, and shortly after leaving the buccal mass, is surrounded for some little distance by a glandular layer of follicular organization, probably salivary in its function: it then continues its course backwards, and, after dipping downwards, bends upwards and empties itself into the posterior part of a small globular stomach, with the ends somewhat flattened, situated on the left side of the body. The interior of this stomach is lined with a broad transverse belt of dark, horny, lancet-formed plates, having their edges and points sharp, and directed towards the centre of the cavity, which they almost fill. This peculiar dental armature is well adapted to cut in pieces alimentary matters.

A wide intestinal tube is given off from this organ, opposite to the entrance to the œsophagus, which tube, running forwards a short way, arches across to the right side of the body, immediately in front of the heart; it then passes backwards in contact with the skin, and terminates at the constricted anal orifice a little in advance of the second branchial lobe.



## SCYLLÆA.

The intestine is somewhat longer and wider than the œsophagus, and is not much less in diameter than the stomach.

The liver holds the same central position as in *Doris* and *Tritonia*, and consists of six or seven globular balls, seated on the ducts that empty themselves by three very large orifices into the stomach just at the termination of the œsophagus. These glandular balls are made up of convoluted tubes, regularly arranged in two concentric layers: the outer one has the tubes small, frequently folded upon themselves, and placed in a radiating manner. The inner layer, which is twice as thick as the outer one, has a like arrangement of the tubes, but they are not so often folded upon themselves, and are much stouter; they are joined at the outer extremities with the tubes of the external layer, and, uniting in pairs at their inner terminations, give off fine transparent ducts, which, passing towards the centre of the ball, unite to form a large central channel, which leads out of the gland and joins one of the ducts above mentioned as emptying themselves into the stomach. Upon the peripheries of these balls, several small tubes ramify in various directions: they appear to come from the convoluted tubes of the gland, and, uniting, go to form a set of canals which lie loosely among the viscera, and between the viscera and the skin; and ramifying over the latter, the principal of them pass into the dorsal lobes, and penetrate the branchial tufts. Six or seven minute branches belonging to the same set of canals, are attached nearly in a straight line along the anterior border of the intestine, just below the stomach, and apparently enter that tube. All these tubes and canals are opaque, and of a yellowish colour like the gland itself; and when examined with the microscope, are found to contain the same glandular substance.

The circulatory system is provided with a strong muscular ventricle, placed a little in advance of the middle of the body, immediately below the dorsal skin. The auricle is united to its posterior extremity, and, as in *Tritonia Hombergii*, is a broad transverse belt receiving branches on each side from the skin. The aorta, as usual, passes from the anterior apex of the ventricle, and divides into arteries for the supply of the viscera.

The nervous system is disposed much in the usual manner. The two central œsophageal ganglia are large, elliptical, and slightly constricted in the middle; the lateral ganglia are much smaller than the central ones, and are nearly circular. The eyes are placed near to the junction of the central with the lateral ganglia.

The generative organs resemble those of *Eolis*. The ovary, however, is described by Cuvier to resemble one of the liver masses, and to be placed with them in the abdominal cavity towards the right side. This we failed to detect in the specimen on which our observations were made, as well as the several accessory parts.

## EXPLANATION OF THE PLATES.

Fig. 1. General view of the viscera of *Scyllæa pelagica*:—*a*, buccal mass; *b*, œsophagus; *c*, folliculated gland surrounding the œsophagus, supposed salivary; *d*, stomach; *e*, intestine; *f*, anal nipple; *g, g, g*, liver masses; *h, h, h, h, h*, branches and tubes passing from the liver masses to the skin and branchial tufts; *i*, ventricle of the heart; *j*, auricle; *k*, cerebral ganglia, with nerves passing from the same; *l, l, l, l*, dorsal lobes, exhibiting branchial tufts; *m*, retracted penis; *n*, convolutions of the testicle.

2. Side view of the buccal mass:—*a*, channel of the mouth; *b*, a portion of the corneous jaw, uncovered by the muscle; *c*, œsophagus; *d*, follicular gland surrounding the œsophagus.

SCYLLÆA.

- Fig. 3. Interior of the buccal mass, exposed from above :—*a*, channel of the mouth ; *b, b*, cutting edges of the corneous jaw ; *c, c*, portions of the jaw exhibited on the surface ; *d*, œsophagus ; *e*, tongue covered with rows of spines.
4. External view of one of the corneous jaws :—*a*, cutting edge.
5. The stomach laid open with two of the liver masses attached :—*a*, interior of the stomach ; *b*, belt of horny plates lining the same ; *c*, œsophagus ; *d*, intestine ; *e, e*, liver balls, showing the tubes branching over their surface ; *f, f*, ducts leading from the liver balls to the stomach ; *g, g*, two of the canals resulting from the union of the tubes that branch over the liver masses and go to the skin.
6. Two of the horny plates from the belt lining the stomach.
7. One of the liver balls bisected longitudinally, exhibiting the internal structure :—*a*, central duct leading to the stomach ; *b*, minute ramifications of the same leading to *c*, the tubes composing the inner layer ; *d*, outer layer of small canaliculated tubes.

### Fam. 3.

(The Figures are included in Pl. 5 of Fam. 2.)

#### Genus 10. EUMENIS,\* ALDER and HANCOCK.

*Corpus* elongatum, quadrilaterum. *Caput* sub-inferius, velo parvo obtectum; maxillis corneis. *Tentacula* duo, dorsalia, clavata, et laminata, intra vaginas retractilia. *Branchiæ* sub-papillosæ, membrano undulato, ad latera dorsi utrinque longitudinaliter extenso. *Pes* linearis. Orificia generationis et ani ad latus dextrum.

This genus was formed by us for the reception of a curious animal found in Torbay; and was published in the 'Annals of Natural History' for November, 1845. Since then we have met with another species in Lamlash Bay, Isle of Arran, agreeing in all essential particulars with the characters on which we had founded the genus, and consequently strengthening our opinion that those characters are generic. In external form this genus very much resembles *Tritonia*, but it differs from it in the papillose character of the branchiæ; in which respect, as well as in its internal structure, it shows a much nearer alliance to the *Eolididæ*, amongst which we have placed it. It constitutes, however, an intermediate form uniting the two families.

The body of *Eumenis* is elongated and quadrilateral, truncated in front, and ending in an obtuse point behind. The head is sub-inferior, with corneous jaws, and is covered by a small tuberculated veil; there are two tentacles, which are dorsal, clavated, and laminated, and are retractile within small, plain, or tuberculated sheaths. The branchiæ are sub-papillose, and arise from a waved membrane set along each side of the back, forming a continuous base from which the papillæ arise into obtuse points. The sides of the body are vertical. The foot is linear, but not very narrow, deeply cleft and arched in front, and extending into long tentacular processes at the sides. The orifice of the generative organs, and the anus are on the right side.

In consequence of our observations having been confined to a single individual in an imperfect state of preservation, the anatomy of this genus has not been very fully made out.

The buccal mass resembles very much that of *Eolis*, but is larger in proportion to the size of the animal, and the muscles, though arranged in the same manner, are more powerful. The corneous jaws differ only in being flatter and shorter. The tongue is placed in the centre of the mouth on a wedge-shaped muscle, and is composed of about fifteen transverse rows of stout, well arched teeth or spines, minutely denticulated on each side, and having their points

\* *Eumenis*, a fury. Since the institution of this genus, we have found, in the volume of 'Reports on Zoology,' lately published by the Ray Society, the description of a genus of M. Verany under the name of *Lomanotus*, which appears to be similar to, if not identical with ours. We regret that our not having had the opportunity of seeing the periodical in which this genus was published, prevented our adopting it. Should it prove the same as ours, we believe M. Verany's name will have the precedence.

## EUMENIS.

directed towards the œsophagus; each row contains about twelve spines. The character of the central portion was not ascertained.

The œsophagus passes from the posterior extremity of the buccal mass, and is a narrow tube of no great extent; the configuration of the stomach was not precisely determined; the intestine terminates at the anal aperture on the right side of the body, about half way between the head and tail. The upper portion of the stomach appears to be granular, and from each side of it arise two tubes. The anterior one passes forwards and gives off branches to the branchial membrane of the sides of the head, which terminate in the papillæ in the form of blind sacs; the posterior tube, sloping a little backwards, penetrates in the same manner the succeeding portion of the branchiæ. The great central canal of the hepatic organ lies below the ovary, as in *Dendronotus*, and, as in that genus, it is thick and glandular throughout, and is much folliculated. From the sides of this portion three or four branches are given off in pairs, penetrating to the branchiæ, as in the rest of the *Eolididæ*. At first these branches are thick, but on reaching the skin they attenuate and ramify over it in a radiating or dendritic manner. All the branches are glandular and folliculated.

The generative organs, as far as we have been able to trace them, resemble those of *Eolis*; the same extensive ovary, composed of lateral lobes, fills almost entirely the posterior portion of the body; the mucous gland, attached to the female parts, is also largely developed, and extends across the anterior cavity of the body, and the testis is a convoluted tube, lying in front, at the right side, immediately behind the tentacle.

The cerebral ganglions are four in number, and are nearly of equal size. The central pair are of a sub-triangular form, and are not placed in contact, side by side, as in *Eolis*, but are united across the median line by a short and stout, though distinct commissure: the lateral pair are attached to the under side of the central ganglions, and are elliptical in form: they are united beneath the œsophagus by a short, stout collar. The buccal ganglions are small and oval, with the collar that joins them to the cerebral ganglions more constricted than in *Eolis*. The nerves, nine pairs of which were made out, radiate from these centres in the usual manner. Ganglions were also observed at the base of the tentacles.

## EXPLANATION OF THE FIGURES.

Fig. 8. General view of the viscera of *Eumenis marmorata*, the dorsal skin being laid open and turned back, and the heart removed:—*a*, buccal mass; *b*, œsophagus; *c*, stomach; *d, d, d*, branches passing from the stomach to the anterior branchial lobes; *e*, intestine; \* *f*, central mass, or folliculated channel of the liver; *g, g, g, g*, branches from the central channel going to the skin and branchial papillæ; *h*, testis; *i*, great mucous gland belonging to the female parts; *j*, ovary, with the posterior portion removed to show the hepatic organ beneath; *k*, cerebral ganglions.

9. Lateral view of the buccal mass:—*a*, œsophagus; *b*, channel of the mouth; *c*, corneous jaws, imbedded in the muscles.

10. Internal view of a corneous plate.

11. External view of the same.

12. Spines, or teeth, from the tongue.

13. Cerebral ganglions:—*a, a*, central pair; *b, b*, lateral pair; *c*, buccal pair.

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\* The intestine, œsophagus, and stomach were imperfectly made out. The delineation of these organs, therefore, is in part from conjecture.





## Fam. 3, Plate 1.

### LARVÆ OF THE EOLIDIDÆ.

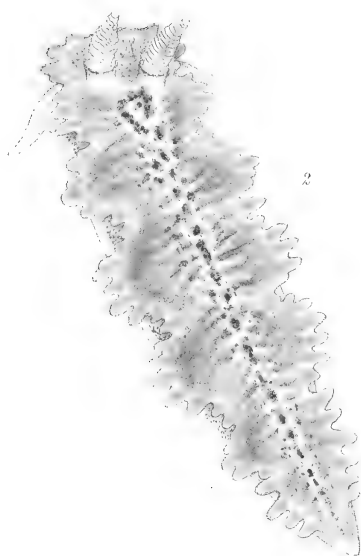
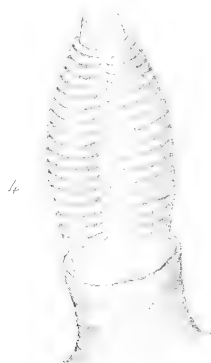
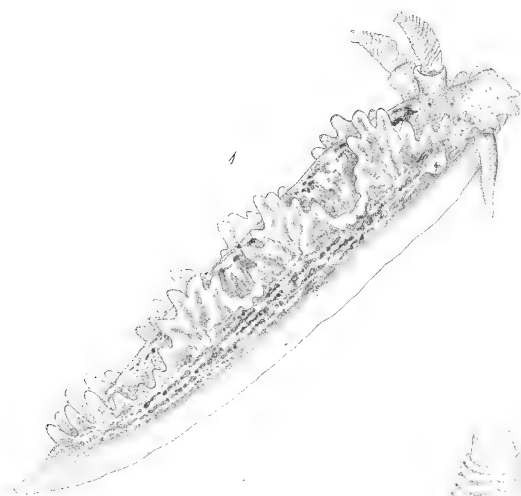
The development of the ova in the *Eolididæ* is so entirely similar to what takes place in *Doris*, that we do not think it necessary here to enter into the details which will be found under the head of that genus. The coil of spawn in this family is generally more slender, and the number of volutions greater than in the *Dorididæ*; but in these respects there is considerable variation in the different groups, as will be seen on referring to the plates of species.

The larvæ undergo only a very slight variation of form throughout the entire order. For the purpose of showing the limits of this variation, we have here given a representation of some of the most distinct forms in the family *Eolididæ*, from which it will be seen how very much they resemble each other. On account of their minuteness the natural size could not be given; it must therefore be borne in mind that the largest of them are only just visible to the naked eye.









Adet A Holmes lithogr

C Hallmandel's Patent.

EUMENIS MARMORATA.

## Fam. 3, Plate 1, a.

### EUMENIS MARMORATA, ALDER and HANCOCK.

E. olivacea, brunneo alboque marmorata: velo parvo, tuberculato: tentaculis clavatis, intra vaginas arctas, simplices, retractilibus: branchiis parvis, papillosis, ad marginem repandum dorsi utrinque dispositis.

*Eumenis marmorata*, Ald. and Hanc. in Ann. Nat. Hist. v. 16, p. 311.

*Hab.* Deep water, Torbay, J. A.

*Body* rather more than half an inch long, nearly linear, quadrilateral, tapering to an obtuse point behind, olive or yellowish brown, streaked and spotted with dark chocolate brown and white. *Head* rather squared in front, covered by a slight veil, with a few tubercular points most conspicuous at the sides. *Tentacles* placed rather forward on the back, ovato-clavate, closely laminated on the upper part, with about twenty plates; the apex produced and truncated. They are of a yellowish fawn-colour; the lower part is plain, and inclosed in rather tight sheaths, with plain margins, extending about one third the height of the tentacles. The sides of the body are produced into a pallial expansion, which undulates into three or four lobes, the margin set with irregular papillose *branchiæ* of a fawn-colour with pale edges; a few separate papillæ extend down to the tail. Down the centre of the back is a line, double in front, of dark chocolate brown or nearly black streaks and spots, commencing in a horseshoe-formed mark behind the tentacles, and reaching to the tail: this line is bordered with streaks of opaque white on each side, sending off lateral branches. The sides of the back are olive or yellowish brown, with dark brown and white spots. On the sides of the body below the branchiæ several interrupted streaks of dark chocolate brown and opaque white extend from the head to the tail; below these the sides are transparent white. *Foot* nearly linear, white; the anterior portion produced into long tentacular processes at the sides, grooved at the margin, and deeply notched in the centre.

A single specimen of this rare and curious nudibranch was dredged near Berry Head, in Torbay. It was a little injured, and lived only a short time after being brought on shore, so that we had no opportunity of observing its habits, and the drawing and description are consequently not so perfect as we could have wished. In form it is less elegant than is usual in this family, but the colours, though sober, have a pleasing effect from the variety and contrast of the markings.

Figs. 1, 2, 3. Different views of *Eumenis marmorata*.  
4, 5. Front and side views of a tentacle.







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C. Hallmandel's Patent Lithogr.

ANATOMY OF DENDROCNOTTUS

## Fam. 3, Plate 2.

### GENUS 11. DENDRONOTUS,\* ALDER and HANCOCK.

*Corpus* elongatum, lateribus compressis, sæpissime lato altus: pallio nullo. *Caput* subinferius, velo parvo, ramoso, obtectum: maxillis corneis. *Tentacula* duo dorsalia, clavata et laminata, intra vaginas retractilia. *Branchiæ* cylindricæ, ramosæ, lineâ unicâ utrinque dorsi dispositæ. *Pes* linearis, gracilis. Orificia generationis et ani ad latus dextrum.

We have found it necessary to institute this genus for the well known *Tritonia arborescens* of authors and its allies, which are distinguished from the true *Tritonia* (*T. Hombergii*, &c.) by the form of their tentacles, the want of a sub-pallial ridge on the sides of the back, and the free arborescent nature of their branchiæ. These characters alone had induced us to consider them generically distinct before we had an opportunity of examining their internal structure; but it was not until we had dissected each that we were aware of the full extent of their differences; the gastric system of *Dendronotus* presenting the ramifications so peculiar to the family *Eolididæ*, while the stomach of *Tritonia* consists only of a simple pouch without appendages, as in the *Dorididæ*; the liver in the former instance being much broken up and occupying the sides of the ramifications, whilst in the latter it forms a single mass in the posterior part of the body. This important character obliges us not only to form of the species so differing a new genus, but to remove them into the family *Eolididæ*, to which, from their structure, they properly belong. Even in an anatomical point of view, however, the genus *Dendronotus* will be found to have only partially assumed the characters of this family, retaining still much resemblance to the *Tritoniadæ*, and constituting one of those transition forms so often found uniting the different types of organization in the animal kingdom.

The body is elongated, much compressed at the sides, and tapering to a point behind. The back is rounded, and has no vestige of a carinated ridge at the sides, or rudimentary cloak, as is observable in *Tritonia*. The veil is short and more or less branched, covering the head, which is sub-inferior and indistinct. There are two tentacles, which are dorsal, clavate, and transversely laminated on the upper part as in *Doris*: they are retractile within sheaths, generally branched at the margins. The branchiæ are arranged in a single line on each side of the back, rising gradually from it at their base, and dividing into cylindrical branches much resembling a tree without leaves, or, perhaps more closely, a branch of coral. This structure is different from that of *Tritonia*, whose branchiæ are composed of flattened leaflets or plumes like those of the *Dorididæ*. We have not been able to detect the ciliary movements on these organs, though we have found cilia in vigorous action along the margin of the foot and on the anal nipple: it is therefore likely that they exist over the whole of the body; and that they cover both the branchial tufts and branches of

\* From δένδρον, a tree, and νῶτος, the back.

## DENDRONOTUS.

the veil, for we have seen the blood passing to and fro in each of these organs so as to leave little doubt of their branchial nature. The foot is linear and slender, formed as much for clasping corallines and sea-weeds as for crawling on a flat surface, though from the thin and pliant nature of its sides it may be used for either purpose. The sexual aperture is situated on the right side below the first branchial tuft, and that of the anus further behind and a little above, between the first and second branchiæ.

The digestive system varies in some respects from that of *Eolis*. The mouth and jaws are the same, the latter varying only a little in form (f. 5). The tongue occupies in the same manner the ridge of a wedge-shaped muscle that rises in the centre of the mouth, and has a similar complicated muscular apparatus for its movement. In *D. arborescens* this organ is composed of upwards of twenty transverse rows of curved, denticulated spines, with a large central one, also denticulated. Each row contains twenty of the small spines, which are brilliantly crystalline, the whole forming a very beautiful object for the microscope (f. 6, 7, 8). On account of the smallness of our specimens we were not able to detect the salivary glands, but as we did not find them outside the buccal mass, they are probably concealed by the jaws, as in *Eolis*. The œsophagus is much larger than usual, and opens into a well-defined stomachal pouch, which terminates in a short intestinal canal that opens on the right side between the first and second branchial tufts. The hepatic organ, however, shows the widest deviation from the structure of *Eolis*. The central vessel in *Dendronotus* is not a mere canal passing from the stomach and receiving the branches from the glands of the papillæ or branchial tufts, but is a large folliculated mass (f. 2, 3) occupying the centre of the body—occupying, in fact, the very position of the liver in the *Dorididæ* and *Tritoniadæ*, and communicating with the stomach by a constricted duct. From this mass branches pass off into the branchiæ and tentacular sheaths: these branches lose their follicular structure and become mere tubes as they pass into the smaller ramifications of these organs. They are lined, however, through their entire length, with the granular substance observed in the other portions of the hepatic apparatus. The sides and upper anterior portion of the stomach are covered with follicular masses, resembling in every respect the great central trunk, which, as well as the stomach, is lined with vibratile cilia. The central trunk of the digestive system lies above the ovarium, and not below it as in *Eolis*. In this respect, as well as in the glandular structure of the central trunk or mass, and in its separation from the stomach by a constricted duct, *Dendronotus* shows a deviation from the type of the *Eolididæ*, and an approximation to the *Dorididæ* and *Tritoniadæ*, thus supplying a connecting link between these two forms of gastric structure in the *Nudi-branchiata*.

The vascular system is furnished with a well-developed heart, consisting of a ventricle and auricle, and in other respects does not appear to differ from the rest of the family.

The nervous system is very similar to that of *Eolis*. The cerebral ganglions are four in number (f. 9,) and are placed symmetrically, giving off nerves much in the order observed in that genus. Of these we have been able to determine ten pairs. The ganglions of the dorsal tentacles (the olfactory ganglions) are larger than usual (9 *a*, *a*,) and are placed at the base of the laminated portion of these organs, consequently at a considerable distance from the cerebral ganglions, to which they are united by large nerves: these form the first pair. The eyes are very small. They are composed of a well-formed pigment cup, a lens, and a



## DENDRONOTUS.

cornea, enveloped in a general capsule (f. 10.) The optic nerves are very long; the eyes are therefore removed to some distance from the large ganglions. The auditory capsules contain numerous otolites of an elliptic form (f. 11, 12.)

The generative organs do not appear to differ from those of *Eolis*, with the exception that the ovarium, as before stated, lies above the central mass of the digestive system.

### EXPLANATION OF THE PLATE.

- Fig. 1. General view of the viscera of *Dendronotus arborescens* :—*a*, buccal mass; *b*, œsophagus; *c*, intestinal canal; *d*, anus; *e, e, e*, branches of the central mass passing into the branchiæ; *f, f, f*, branches of the same passing into the tentacular sheaths; *g*, ventricle of the heart; *g'*, auricle; *h*, cerebral ganglions; *h'*, olfactory ganglions; *i, i*, portion of the generative organs; *j*, ovarium.
2. Digestive system :—*a*, buccal mass; *b*, œsophagus; *c*, stomach; *d*, intestine; *e*, duct connecting the alimentary canal with the liver; *f, f, f*, branches of the central mass passing into the branchiæ; *g, g*, branches from the same passing into the tentacular sheaths; *h, h*, central portion of the liver.
  3. A portion of the digestive system seen in profile, showing the duct connecting the liver with the stomach. The letters of this figure correspond to those of fig. 2.
  4. Buccal mass.
  5. Jaws deprived of their muscles.
  6. Tongue.
  7. A portion of the same more highly magnified.
  8. Dorsal view of the same.
  9. Cerebral ganglions showing the origin of the principal nerves :—*a*, ganglions of the dorsal tentacles (olfactory ganglions;) *b, b*, the eyes.
  10. The eye more highly magnified.
  11. Auditory capsule with otolites.
  12. Otolites more highly magnified.







## Fam. 3, Plate 3.

### DENDRONOTUS ARBORESCENS, MULLER.

*D. rufescens*, brunneo marmoratus : velo fasciculis ramosis 4 ornato : branchiis arborescentibus 6-7 utrinque dorsi dispositis.

*Doris arborescens*, Mull. Zool. Dan. Prod. 229. Fab. Faun. Grœnl. 346. Gmel. v. 1, p. 3107, No. 25.

*Doris cervina*? Gmel. v. 1, p. 3105. No. 12.

*Tritonia arborescens*, Cuv. in Ann. du Mus. v. 6, p. 434, pl. 61, f. 8, 9, 10. Lam. An. s. Vert. 2d Ed. v. 7, p. 454. Flem. Brit. Anim. p. 284; Johns. in Ann. Nat. Hist. v. 1, p. 115; Gould. Inv. Massach, p. 5.

*Tritonia Reynoldsii*, Couthouy in Bost. Journ. Nat. Hist. v. 2, p. 74. Pl. 2, f. 1-4.

*Var. a.* Hyaline white. (*Fide* Gould.)

*Tritonia lactea*, Thomp. in Ann. Nat. Hist. v. 5, p. 88, pl. 2, f. 3.

*Var. b.* Pink, with opake yellow tubercles.

*Tritonia pulchella*, Ald. and Hanc. in Ann. Nat. Hist. v. 9, p. 33.

*Hab.* In crevices of rocks, under stones, and upon sea-weeds and corallines, between tide marks, and in shallow water; not uncommon in the north. Loch Broom, Ross-shire, and Zetland Islands, Rev. Dr. Fleming. Aberdeen, Professor Macgillivray. Oban Bay, Argyleshire, J. A. Frith of Forth, Dr. Grant. Isle of Man, Professor E. Forbes. Lough Strangford, W. Thompson, Esq. Dublin Bay, and Malahide, Ireland. Whitly and Cullercoats, Northumberland. Torbay.

*Body* nearly two inches long, linear oblong, rather higher than broad, rounded above, and compressed at the sides; variable in colour, but generally of a reddish hue, streaked and marbled with brown, and with small opake white or yellow tubercular spots. The most usual variety has reddish brown markings on a yellowish ground. It is, however, not unfrequently of a cold sepia colour. The markings are somewhat symmetrically placed on the sides of the head and shoulders, and along each side of the back between the branchial processes, and there are also two narrow interrupted streaks down the centre of the back. *Tentacular sheaths* nearly as long as the branchial tufts, and set rather apart from each other. They are divided for about half their length into four, or sometimes five, branches: these branches are generally subdivided, and there is also a small branch on the outside of the sheath about half way down. *Tentacles* clavate, strongly and broadly laminated on the upper part, with five or six large plates, and intermediate smaller ones, of a pale yellowish brown. They are aptly compared by Fabricius to a panicle of hops. *Veil* very short, with four principal branched appendages and smaller ones between them. Beneath, on the upper surface of the lips, there are a few small simple appendages of a similar character, and on each side of them a slight tentacular prolongation. *Branchiæ* beautifully arborescent; the stem nearly cylindrical, and rising gradually from the back. They are delicately transparent, of the same colour as the body, with dark and opake yellow or white spots, the latter slightly tubercular. In most individuals the colour of the central vessel is seen through.

## DENDRONOTUS ARBORESCENS.

There are six or seven pairs diminishing in size towards the tail, which does not extend far beyond them. In fine old specimens there are also smaller intermediate tufts. The anterior pairs have four or five principal branches, which are divided and subdivided into numerous delicate points. The posterior ones are less branched. *Foot* very narrow, linear, rounded in front, the sides thin, and adapted for clasping. The heart forms a large swelling between the first and second pairs of branchial tufts. It pulsates about seventy-six times in a minute. The eyes are placed on the sides a little below the tentacular sheaths, and are very small.

The young are very pale, and the spots exceedingly delicate: in this state the digestive system is distinctly seen extending nearly the whole length of the body, and giving off branches into the arborescent tufts and tentacles.

When fully developed this is a splendid animal. It is subject to much variation in colour, which has given rise to some spurious species. Occasionally we have met with an individual perfectly white and transparent, showing the coloured viscera within. This we take to be the *Tritonia lactea* of Mr. Thompson. Another beautiful variety, which we formerly described under the name of *Trit. pulchella*, is much smaller, and of a uniform pale rose-pink, with yellow tubercles. The *Trit. felina*, also described by us in the 'Annals of Natural History,' may possibly be another variety, but as there are some little differences of form and consistence, we prefer keeping it apart at present.

These molluscs crawl but slowly on a plain surface, but on corallines they move with graceful facility, their tree-like plumes waving at every turn. Frequently, clasping the coralline with only a small portion of the foot, they will remain suspended by it, moving their bodies about in all directions.

Dr. Grant has given a curious account of sounds emitted by these animals, which he conceives to proceed from the action of the jaws. Though we have frequently kept them alive for several days together, we could never succeed in detecting any sound. It may possibly only be produced under peculiar circumstances.

*Dendronotus arborescens* appears to have a wide range in the northern seas, extending from Greenland to the shores of the English channel; and it is again met with on the north-east coast of America.

Its spawn is deposited in the spring months, at which period large individuals may usually be found among the rocks between tide marks. The young, however, occur all the year round. The spawn is of a pale yellow or rosy colour, and is about twice coiled; the ova are arranged in a small cord doubling upon itself as in the spawn of *Eolis papillosa*, which this greatly resembles, but is not quite so large.

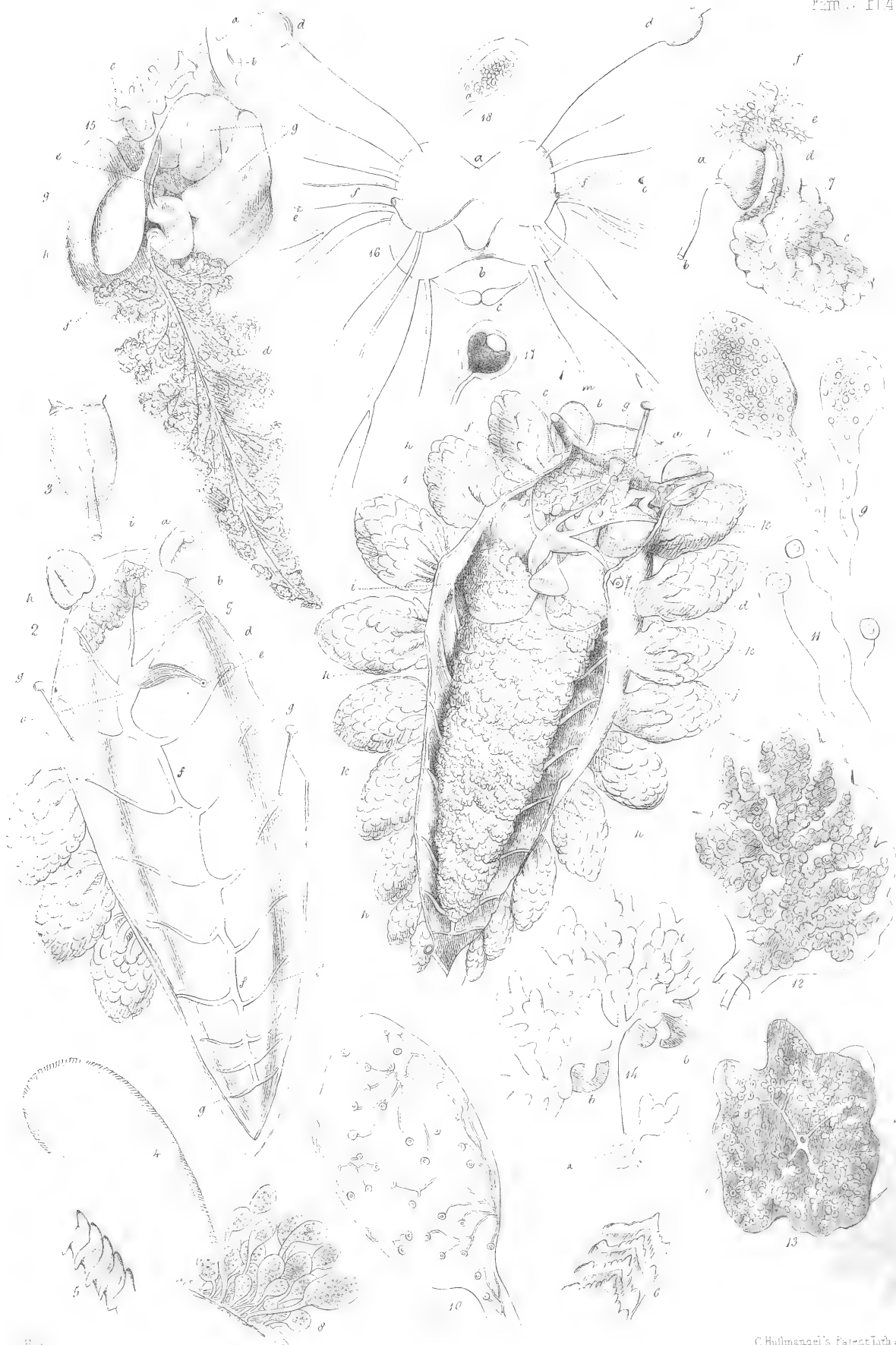
Fig. 1. *D. arborescens*, usual appearance.

2. Light red variety.

3. White variety, (*Tritonia lactea*, Thomp.)

(The figures in this Plate have been inadvertently reversed.)





ANATOMY OF DOTO.



### Fam. 3, Plate 4.

#### GENUS 12. DOTO,\* OKEN.

*Corpus* limaciforme, elongatum: pallio nullo: *Caput* terminale, velo parvo obtectum. *Tentacula* duo, dorsalia, linearia, intra vaginas patentes retractilia. *Branchiae* clavatae vel ovatae, tuberculis verticillatis muricatae, lineâ unicâ utrinque dorsi dispositae. *Pes* linearis. Orificia generationis et ani ad latus dextrum.

The genus *Doto* was established by Oken in his 'Lehrbuch der Naturgeschichte,' published at Jena in 1815,† for the *Doris pinnatifida* and *D. maculata* of Montagu. This genus has been overlooked by most of the subsequent writers on the *Nudibranchiata*, who have erroneously placed the species belonging to it in other genera—*Tritonia*, *Tergipes*, &c. More recently they have been referred to *Melibæa*. M. Sander Rang formed the latter genus for a mollusk obtained by him on floating sea-weed near the Cape of Good Hope, and first published it, we believe, in his 'Manuel des Mollusques,' in 1829. It approaches very near to *Doto*, but differs in having a large funnel-shaped veil fringed inside like that of *Thethys*, and a probosciform mouth. These differences, we think, are sufficient to warrant our considering the two genera distinct: but however that may be, the name of *Doto* has an undoubted priority, and must be adopted for our British species.

This genus has generally been considered to be allied to *Tritonia*. An examination of its internal structure, however, proves its greater affinity to *Eolis*, not only in its branched digestive system, but also in the liver being entirely placed in the branchial processes; in which respect it shows much more decidedly the typical characters of the family than *Dendronotus*, though allied to that genus in external form, and consequently placed in the same sub-family. It is also related to *Dendronotus* by the position of the ovarium, which is above the central vessel or hepatic duct. By this circumstance, as well as in the largely developed salivary gland, it shows an alliance to the *Dorididae*, and forms another link in the chain of affinities that unites the order.

The body of *Doto* is limaciform and elongated, rounded on the back, and without any cloak or carinated ridge. The head is covered by a short veil, plain at the edges. The mouth is small, round, and puckered. There are two tentacles which are slender and linear, retractile within sheaths, usually expanded and curved outwards at the top: they are situated dorsally nearly above the mouth.

The branchial processes are arranged in a single row along each side of the back. They are of an ovate or clavate form, slightly pedunculated, and covered with transverse rows of bluntly-pointed tubercles, capable of extension and contraction. These processes

\* *Doto*, a sea-nymph.

† The name has since been used by De Haan for a genus of *Crustacea*, published in 1836; and we believe also, by Guérin, for another genus of crustacea, during the same year.

## DOTO.

very readily fall off, and possibly may be detached, as Professor E. Forbes supposes, at the will of the animal, but of this we have not been able to satisfy ourselves. Their deciduous character has been thought by some to offer a decided objection to their being considered as branchiæ, and indeed the animal is quite capable of surviving the loss of the whole of these processes; but as it is now very well ascertained that the mollusca of this order respire also by the skin, even in cases where the branchial organs are more decidedly specialized, we see no good reason for withholding the name of branchiæ from these organs, though they may perform that function less perfectly than the processes of some other genera of the order. The foot is linear, and generally rather narrow. The anus is dorsal and lateral, forming a small nipple on the right side between the first and second branchial processes. The aperture of the generative organs is placed below the first branchial process on the right side.

The anatomy of *Doto*, notwithstanding its general similarity to that of *Eolis*, differs from it in some interesting particulars.

The digestive system has the buccal mass much smaller than usual, of an oval form, and unprovided with corneous jaws. The tongue is curved and placed in the mouth as in *Eolis*; it is stiff, slender, and exceedingly small, and is composed of upwards of a hundred transverse plates each supporting a central tooth, directed backwards, and appearing, when highly magnified, a little denticulated at the sides. From the small size and weak armature of the mouth, compared with other genera, we think it likely that the animals of this genus feed only on the soft parts of the corallines, on which they are generally found. The salivary gland is ample. It lies above the generative organs on the left side of the body, and extends forward to the buccal mass, opening by a slender duct immediately before it through the inferior wall of the channel of the mouth. There is likewise another gland connected with the channel of the mouth which is probably accessory to the above, though it differs from it in structure. It is much smaller, and is composed of numerous minute oval sacs, each furnished with a delicate and suddenly constricted duct: these sacs surround the channel of the mouth, and pour the secretion into it on all sides just where it receives the duct from the large salivary gland. With a high magnifying power they appear to be covered over the inner surface with nucleated cells, having minute vessels passing from them, which ramify over the inner surface of the sacs and unite as they descend towards the ducts. The size of the vessels corresponds exactly with the diameter of the nucleus.\*

The œsophagus is long, very slender, and passes from the upper posterior dorsal aspect of the buccal mass, increasing a little in size as it reaches the stomach, which is small and elongated. The interior is minutely granulated, but does not appear to be raised into folds or wrinkles. The intestine is very short and wide, especially at its junction with the stomach, which takes place further forward than usual on the right side: the inner surface is plicated longitudinally; the plicæ end abruptly as they reach the stomach. From this peculiarity of structure, and the great width of the intestine, it seems probable that it may have some other function to fulfil than that of conveying off the refuse of digestion. May it not be in this canal that the nutritive portion of the food is absorbed into the digestive

\* We have been thus minute in the description of this gland, as we think it likely to throw some light on the ultimate structure of glands in general. We should suggest the probability that the nucleus of the cell of glandular tissue may be nothing more than the orifice of a minute vessel, or perhaps, in some cases, a mere opening through which the secretion passes.

## DOTO.

system? The anus opens on the right side of the back, as stated above. Two delicate vessels or ducts pass from the anterior portion of the stomach to the first pair of branchial processes: the other branchial processes receive similar vessels from a central vessel which passes from the posterior extremity of the stomach, and extends the whole length of the body beneath the ovarium. The lateral vessels alternate a little, and are not always symmetrical: the last pair arise from the extreme posterior point of the central vessel.

The hepatic glands are very highly organized, and almost fill the branchial processes, with the exception of small passages hollowed out of the glandular mass, probably for the circulation of the blood. There are no distinct sheaths as in *Eolis*, though we have observed between the gland and the outer skin in *D. coronata*, a sort of network of fleshy columns similar to what we have seen between the outer and inner sheaths of the papillæ of *Eolis papillosa*. On placing one of the smaller branchial processes of *D. fragilis* in the compressor of the microscope, the gland is discovered to be of a highly racemose character: but for the complete understanding of its structure it is necessary to make a transverse section of one of the larger processes, when the gland is perceived to be highly complicated and delicately branched. The branches radiate from a minute central duct, and are much divided and crowded with follicles: their extremities reach into the papillæ. The completeness of this organ as a secreting apparatus must be evident to physiologists, as well as the improbability of its subserving any other function.

Respiration is undoubtedly performed by the surface of the body as well as by the branchial processes. Immediately beneath the skin of the body in *D. coronata*, is the same network of fleshy columns observed in the branchial processes of that species; and both in it and in *D. fragilis*, the entire surface is covered with vigorous vibratile cilia. Cilia are also on the branchial processes, but are most vigorous towards their bases.

The heart is as completely organized as in any of the order: the ventricle is strong and muscular, the auricle thin and membranous.

The nervous system is furnished with four cerebral ganglions of nearly equal size, and two small buccal ganglions of the usual form. The nerves are arranged much as in *Eolis*. There appear to be about ten principal pairs, and a few smaller ones, which we were unable to trace. The olfactory ganglions are at some distance from the cerebral ganglions to which they are united by large nerves: they are round, and placed at the bases of the tentacles. The eyes are also placed a little way from the cerebral ganglions, and are very small. The otoliths of the auditory capsule are numerous and elliptical.

The generative organs do not materially vary from those of *Eolis*. The ovarium, however, is above the great central vessel of the digestive system.

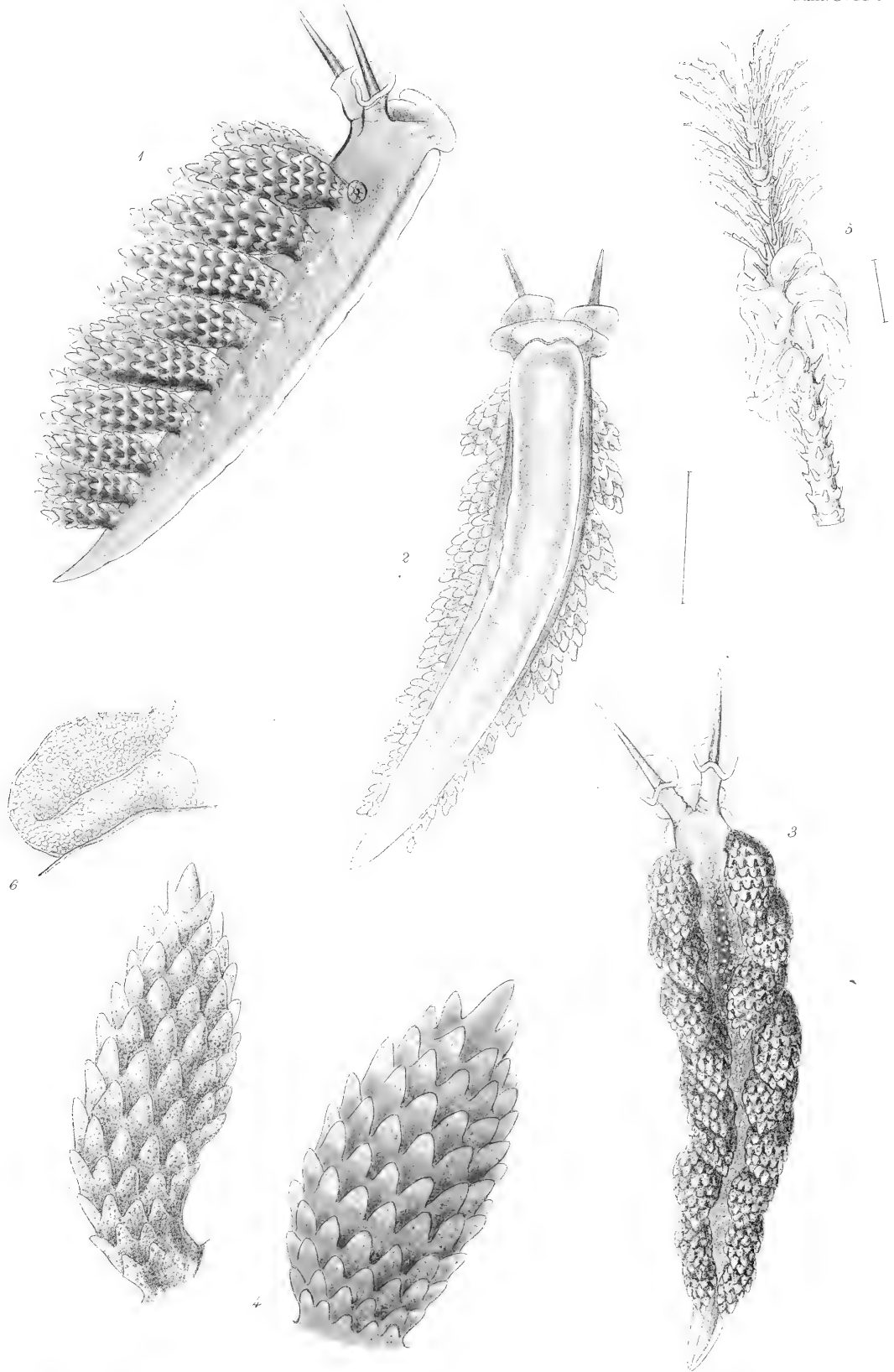
## EXPLANATION OF THE PLATE.

- Fig. 1. General view of the viscera of *Doto fragilis*, seen from above:—*a*, buccal mass; *b*, œsophagus; *c*, stomach; *d*, intestine; *e*, anal nipple; *f*, salivary gland; *g*, accessory salivary gland; *h, h, h, h*, lateral vessels or ducts leading from the branchial glands to the central vessel connected with the stomach; *i*, ventricle of the heart; *j*, auricle of the same; *k, k, k*, generative organs; *l*, cerebral ganglions; *m, m*, olfactory ganglions.
2. The digestive apparatus exposed:—*a*, buccal mass; *b*, œsophagus; *c*, stomach; *d*, intestine; *e*, anus; *f, f*, great central duct; *g, g, g, g*, lateral ducts from the branchial glands; *h*, salivary gland; *i*, accessory salivary gland.

DOTO.

- Fig. 3. Dorsal view of the buccal mass.
4. Side view of the tongue.
  5. A portion of the same more highly magnified.
  6. A portion of the same seen from above.
  7. Buccal mass with salivary gland:—*a*, side view of the buccal mass; *b*, œsophagus; *c*, salivary gland; *d*, duct of the same; *e*, accessory salivary gland; *f*, channel of the mouth.
  8. A portion of the accessory salivary gland more highly magnified.
  9. Two of the sacs of the same, increased in size.
  10. A single sac of the same, still more highly magnified, exhibiting the nucleated cells and the vessels? leading from them (the cells on the under side are not shown.)
  11. Three of the nucleated cells with the vessels attached.
  12. A lateral view of one of the smaller branchial processes, as seen in the compressor of the microscope.
  13. A transverse section of one of the larger branchial processes showing the complicated structure of the gland:—*a*, central duct.
  14. A single branch of the same more highly magnified:—*a*, central duct; *b, b*, blood passages.
  15. Generative organs.
  16. Cerebral ganglions and nerves:—*a*, upper ganglions; *b, b*, lateral or under ganglions; *c*, buccal ganglions; *d, d*, ganglions of the dorsal tentacles (olfactory ganglions); *e, e*, eyes; *f, f*, auditory capsules.
  17. Eye of *D. coronata*.
  18. Auditory capsule of the same.





A. Hancock del. W. Wing lith.

*DOTO FRAGILIS.*

C. Hullmandel's Patent Lithogr.

## Fam. 3, Plate 5.

### OTO FRAGILIS, FORBES.

*D. luteo-fusca* vel olivacea; velo fastigiis duobus lateralibus; vaginis tentaculorum sursum expansis; branchiis utrinque 9, robustis, ovato-conicis, tuberculorum seriebus 7—9 obsessis.

*Tritonia pinnatifida*, Johns., in Loud. Mag. Nat. Hist., v. 8, p. 61, f. 4.

*Melibæa pinnatifida*, Johns., in Ann. Nat. Hist., v. 1, p. 116.

(*Oto*) *fragilis*, Forbes, Mal. Mon., p. 4, pl. 1, f. 4.

*Hab.* In deepish water, generally in the coralline zone. Berwick Bay, *Dr. Johnston*. Newbiggin and Cullercoats, Northumberland; and Whitburn, Durham, *J. A.* and *A. H.* Ballaugh, Isle of Man. *Professor E. Forbes*. Clew Bay, County Mayo, *W. Thompson, Esq.* Oban Bay; Lamlash Bay, Arran; Torbay; and Fowey Harbour, Cornwall, *J. A.*

*Body* about an inch in length, linear, and rather stout, nearly opaque, of a brownish-yellow colour varying to olive, with a few tubercular yellow spots along the top of the back, and a few clustered white ones on the sides below the branchiæ. *Tentacles* of a rich olive brown, long, filiform, and tapering; issuing from wide trumpet-shaped sheaths, a good deal expanded in front, and waved at the margin. They are placed far forward, and close together. *Veil* short, a little arched in front, produced and rounded at the sides. An elevated ridge runs from the base of each tentacular sheath along the sides of the veil, terminating before it reaches the margin. *Branchiæ* nine pairs; large, ovate, stout, and closely set on the back; they are attached by a broad base, scarcely pedunculated, and have somewhat of a pine-apple form. The papillæ covering their surface are in seven to nine rows, with a terminal papilla at the apex: the larger circles contain ten or twelve papillæ each. They are obtusely pointed, and capable of considerable elongation; generally they are of a nearly uniform yellowish-brown, sometimes yellowish or greenish-olive; the upper portion of each is usually paler than the lower, and has a granular appearance; they are very minutely freckled with white. *Foot* of a pale yellowish olive, rounded and slightly indented in front, and tapering to a point behind.

This fine species was first noticed by Dr. Johnston, who took it for the *Doris pinnatifida* of Montagu, which we have elsewhere given our reasons for considering a variety of *D. coronata*. The terminal spot on the papillæ is never found in *Oto fragilis*. This species appears to be pretty widely diffused in the British seas, but has not yet been noticed by continental naturalists. It is generally found on corallines, especially on *Antennularia antennina*, at the roots of which, one or two of these mollusks may frequently be found nestling, but so near is their colour to that of the zoophyte, that they can scarcely be observed without a careful inspection. They appear to feed upon this zoophyte, and it also affords them a place of

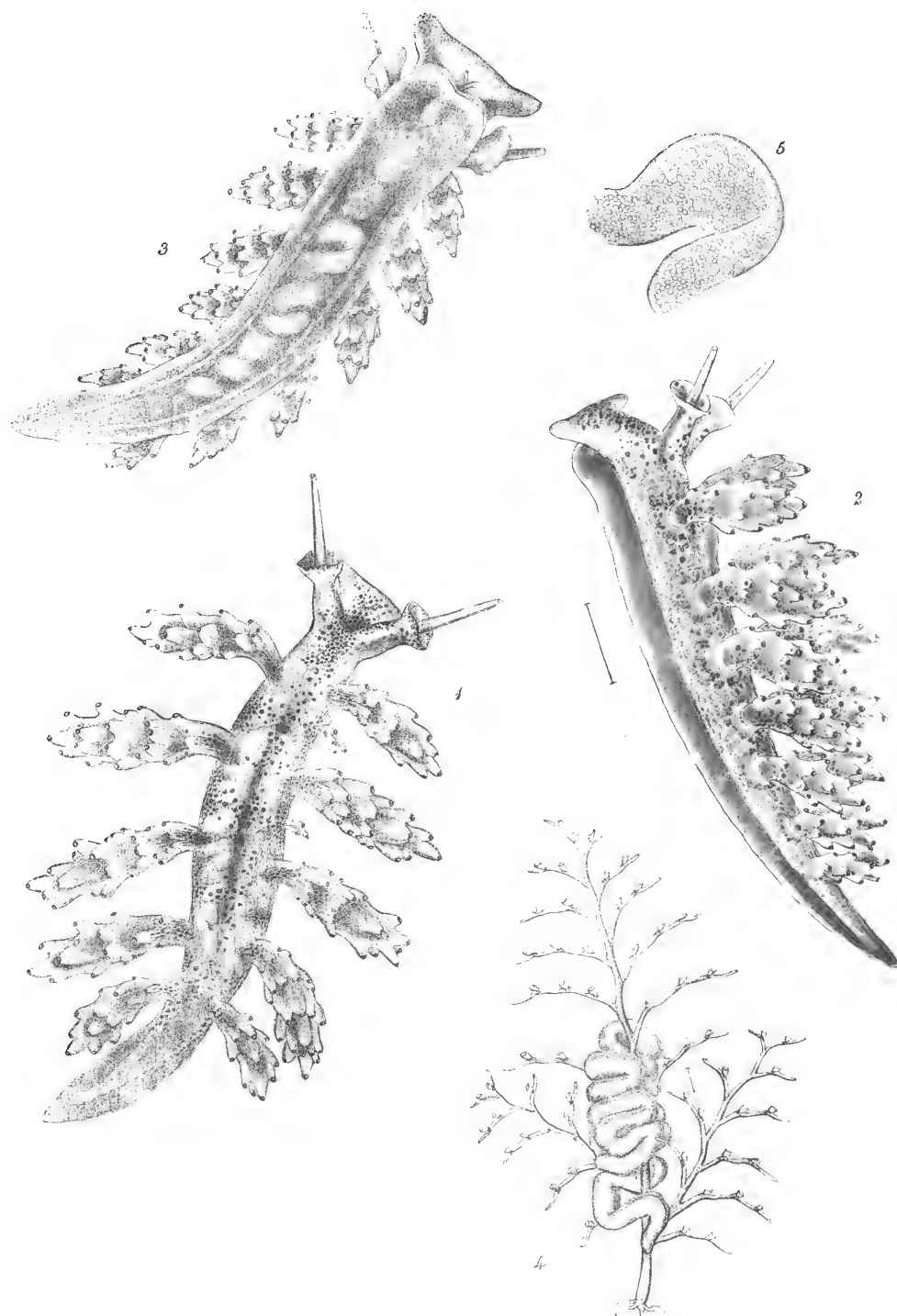
## DOTO FRAGILIS.

deposit for their spawn, which invests the stems of *Antennulariæ* in transverse folds, so tightly packed, that the windings cannot readily be traced. The ova are densely imbedded in a flattened, gelatinous strap of moderate breadth; this does not form a continuous spiral, but is reflected upon itself at each volution, so as to leave a small portion of the stem of the coralline uncovered. We have taken the spawn in October. This is a very inactive animal, moving slowly, and rarely swimming; when removed out of the water, on account of the firmness of its tissues, it does not collapse like most of the *Eolididæ*. The branchiæ are very apt to fall off, hence its name.

- Figs. 1, 2, 3. *Doto fragilis* in different positions.  
4. Branchiæ, more highly magnified.  
5. Spawn.  
6. A portion of the same more highly magnified.







A. B. del.

C. Hallmandel's Fauna Antiquaria.

*DOTO CORONATA.*

### Fam. 3, Plate 6.

#### DOTO CORONATA, GMELIN, *Sp.*

*D. flavescens*, rubro maculata: velo truncato: branchiis utrinque 5-7; ovato-clavatis, tuberculatis, apicibus puniceo punctatis.

*Doris coronata*, Gm. 1, p. 3105, No. 19.

*Doris pinnatifida*? Mont. in Linn. Trans. v. 7, p. 78, pl. 7, f. 2, 3.

*Tritonia pinnatifida*? Flem. Brit. Anim. 284.

*Tritonia coronata*, Lam. Anim. s. vert. 2d ed. v. 7, p. 454.

*Tergipes coronata*, D'Orb. in Mag. de Zool. 1837, v. 5, pl. 103.

*Scyllæa punctata*, Bouch. Chant. Moll. de Boul.

*Melibæa coronata*, Johns. in Ann. Nat. Hist. v. 1, p. 117, pl. 3, f. 5-8.

*Melibæa ornata*, Ald. and Hanc. in Ann. Nat. Hist. v. 9, p. 34.

*Doto coronata*, Lovén in Arch. Skand. Nat. p. 151.

*Hab.* On corallines from deep water, not uncommon; also among the rocks at low-water mark. Frith of Forth, *Dr. Grant*. Berwick Bay, *Dr. Johnston*. Isle of Man, *Professor E. Forbes*. Woodside, near Liverpool, *J. Price, Esq.* Glendore Bay, county Cork, *Professor Allman*. Dublin Bay and Malahide. Oban Bay, Argyleshire. Cullercoats, Whitley, and Newbiggin, Northumberland. Marsden, Durham. Torbay and Salcombe, Devonshire.

*Body* about half an inch long, nearly linear, slender, smooth, semitransparent, pale yellow or buff, spotted with reddish or brownish purple. The spots usually form a broad interrupted line from the front of the head almost to the tail; from this, belts of similar spots pass transversely between the branchial processes and blend with a line of spots that passes along each side. *Tentacles* filiform, truncated at the tip, and transparent, issuing from rather long trumpet-shaped sheaths; wide at the top and more produced anteriorly; set near together at the base and diverging above. *Veil* entire, straight in front, produced and rounded at the sides, and capable of extension and contraction in a lateral direction. *Branchiæ* from five to seven pairs; the last frequently rudimentary, the rest nearly of equal size, large in proportion to the animal, elliptical, pedunculate and muricate, semitransparent, having four or five circles of tubercles and a terminal one at the apex: the tubercles are capable of extension and contraction, and each is surmounted by a dark red spot, sometimes nearly black. The central portion of the branchiæ is generally of a brownish rose-colour, sometimes purple-brown, and occasionally pale buff or olive. *Foot* transparent white, tinged with yellow, rounded and somewhat bilobed in front; the margin slit transversely; ending in an obtuse point behind.

The heart forms a slight swelling on the back, between the first and second pairs of branchial processes. It pulsates 60 times in a minute.

This is a very beautiful and delicate little animal. It is liable to great variation in colour, and the spots are frequently jagged, and produced into streaks. The body is occasionally almost colourless, and nearly devoid of any sort of markings; and we have seen it entirely of a beautiful rose colour, with the body nearly covered with confluent purple or

#### DOTO CORONATA.

puce-coloured spots, relieving with great force the delicate rose-coloured branchial processes. Sometimes the body is bright yellow, with the spots both on it and on the branchiæ, of a fine carmine; and another variety occurs with the branchial processes nearly colourless, being tinged only with a watery green, and having the spots almost black.

*Doto coronata* is found on all parts of our coast that have been properly examined, and may be considered amongst the most common of our deep water species. Its favourite haunt is amongst the corallines that grow at a short distance from the shore, in between fifteen and twenty fathoms water: of these it appears to prefer *Plumularia falcata* and *Sertularia abietina*. Dr. Johnston states that he found about a dozen specimens on one tuft of *Plumularia Catherina*. It is also frequently found on *Sertularia pumila* among the rocks at low-water mark.

This species is found on the French, Dutch, and Swedish coasts, so that its range probably extends through the whole of the European seas.

The spawn is always found on corallines; the ova are white and deposited in a thick gelatinous riband, which is folded on the stem of the coralline in a zig-zag manner. July appears to be the height of the breeding season; spawn, however, occurs both in June and August.

After having been referred to at least six genera by different authors, this little animal, it is to be hoped, may at last find a resting-place in the genus to which, following Dr. Lovén, we have now consigned it.

The *Doris pinnatifida* of Montagu, which we place with doubt as a synonym of this species, is still involved in much obscurity. We had hoped, while on the Devonshire coast, to have satisfactorily made out that species, especially as we explored Montagu's favourite dredging grounds, and, while in Salcombe estuary, had the assistance of the boatman who was accustomed to attend him. Our search for this and some others of Montagu's lost species was, however, without success. *Doto coronata* was found at Salcombe, and we also met with the same species in Torbay as well as *Doto fragilis*. Is it not possible, therefore, that one of these may really be the *Doris pinnatifida*? Dr. Johnston thought that he recognized it in the latter, but we are of opinion, from its small size, slender form, and the spots on the tips of the branchial tubercles (an almost invariable character in *D. coronata*, but never found in *D. fragilis*), that it is much more likely to belong to the former species. There is, in fact, nothing in Montagu's description, if we except, perhaps, the colour, and an additional row of tubercles on the branchiæ,\* which does not agree with the characters of *D. coronata*. The figure is less like it, but some allowance must be made for the evident want of skill in the artist. The number of branchial processes is not mentioned in the description, but nine pairs are represented in the figure, a number beyond what we have ever found in *D. coronata*, though in one instance we have seen it with eight pairs; it is, however, still less like the young of *D. fragilis*, which, when no larger than Montagu's specimen, has only six pairs of branchial processes, and no more than three or four rows of papillæ, and is, moreover, entirely without spots. Further observations may throw additional light on the subject, but should

\* M. D'Orbigny's *Tergipes coronata*, which we have given as a synonym of our species, has the same number of rows of tubercles as Montagu's *Doris pinnatifida*.

#### DOTO CORONATA.

no other species be found agreeing better with the description and figure, the occurrence of *D. coronata* on that part of the Devonshire coast may afford a fair presumption of its identity with the long lost *Doris pinnatifida*.

Another of Montagu's species, referrible to this genus, stands in a somewhat similar predicament; namely, *Doris maculata*, which agrees with the present species in the form, colour, and markings of the body, but differs in the branchiæ being much smaller and with only one whorl of tubercles. We have occasionally found *D. coronata* with one or two of the processes of a similar form to this, either from the individuals being young, or from new branchiæ being in process of reproduction where others had fallen off. We have never met with an individual with all the branchiæ in this state, but the possibility of such an occurrence induces us to look upon this species also with some suspicion.

A more complete examination of the species on the southern coast is very desirable.

Fig. 1, 2, 3. *Doto coronata*, different views.

4. Spawn.

5. A portion of the same more highly magnified.

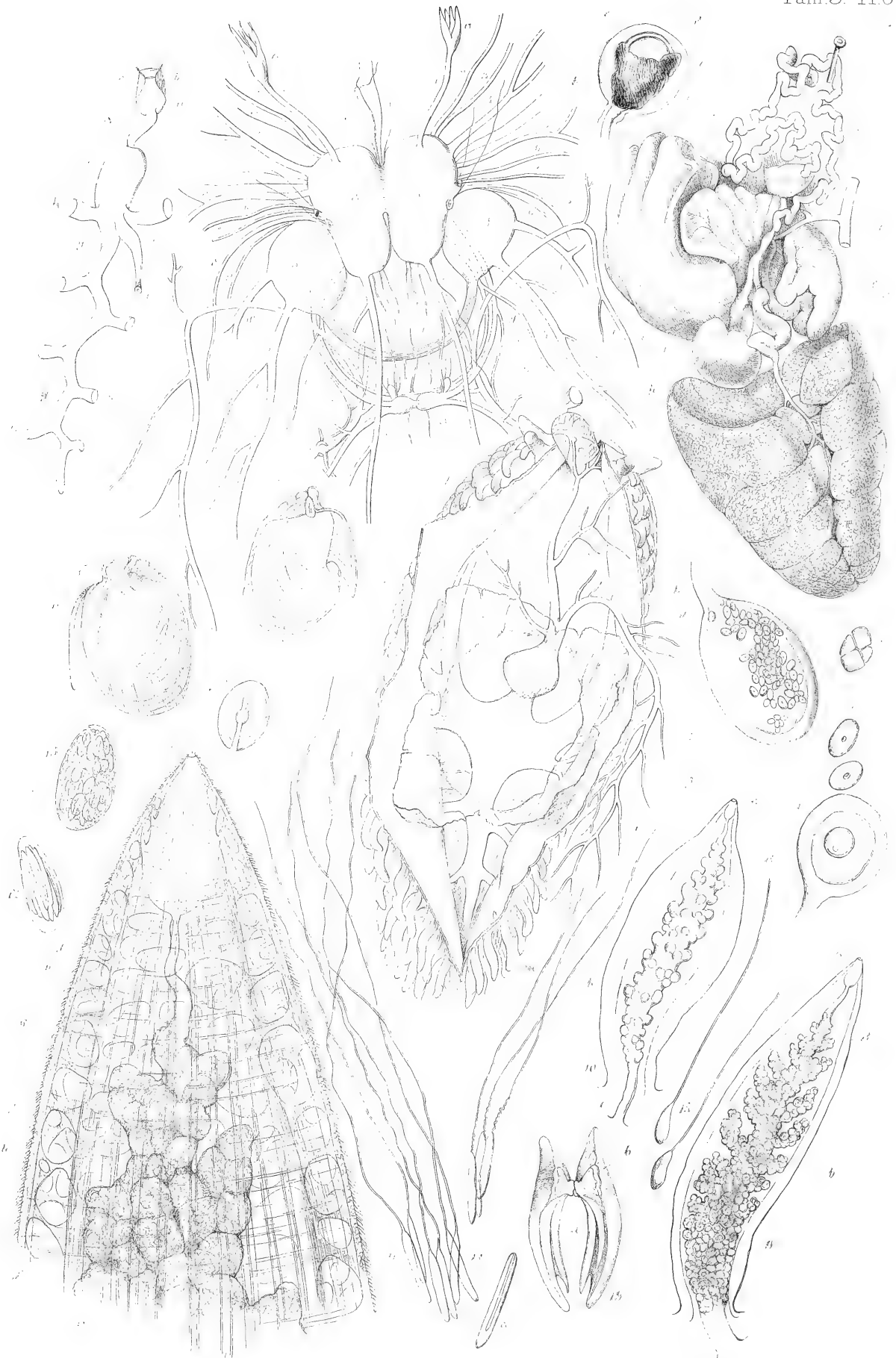












## Fam. 3, Plates 7 and 8.

### GENUS 13. EOLIS,\* CUVIER.

*Corpus* limaciforme, ovatum aut lineare: pallio nullo. *Caput* terminale, tentaculis 4, non-retractilibus, linearibus; quorum 2, labiales et 2 dorsales sunt. *Maxillæ* corneæ. *Branchiæ* simplices, elongatæ, papillosæ; in dorso seriatim aut fasciculatim dispositæ. *Pes* sub-linearis postice acuminatus, nonnunquam angulis anterioribus valdè extensis. *Orificia* generationis et ani ad latus dextrum.

Cuvier was the first to establish this genus, in his celebrated 'Mémoires des Mollusques,' originally published in the 'Annales du Museum.' It was subsequently adopted by Lamarck. Its limits, however, have been but imperfectly understood: Cuvier himself detached from it two genera in the 'Règne Animal,' namely, *Tergipes*, founded upon the *Limax tergipes* of Forskal—which was erroneously supposed by its discoverer to be able to crawl by means of suckers at the ends of the dorsal papillæ—and *Flabellina*, founded upon a species described by Cavolini, in which the papillæ are arranged in tufts. The *Cavolina* of Bruguière (named in a plate of the 'Encyclopédie Méthodique') is also considered by some to constitute a genus apart from *Eolis*, while others consider the two as synonymous, and claim for the name of Bruguière a priority over that of Cuvier. We have not the means of ascertaining the respective dates, but the naming of two figures in a plate with which no description was published, can scarcely be considered to amount to the establishment of a genus, especially as other species, apparently belonging to the same genus (and now considered to be *Eolidæ*), were figured in the adjoining plate under the name of *Doris*. In the letter-press of this department of the 'Encyclopédie,' afterwards contributed by M. Deshayes, he states his belief that Bruguière had abandoned the genus *Cavolina*, and that it ought to merge into *Eolis*. In this opinion we agree, as well as in considering *Flabellina* and *Tergipes* merely as sections of this genus. Other genera have been established out of different varieties of *Eolis*, which we are by no means inclined to admit. Of these, *Montagua* of Fleming, *Ethalion* of Risso, and *Eolidina* of Quatrefages may be taken as examples. Further reasons for discarding some of these will be mentioned in treating of the species which have been referred to them. The genus *Eolis*, such as we now understand it, contains a large number of species, the greater part of which are found in European seas, and nowhere so numerous as on the British shores. We are inclined to

\* From *Æolis* the daughter of *Æolus*, god of the winds. The name of this genus has been written differently by different authors. In the 'Mémoires des Mollusques' Cuvier contents himself with giving the name in French (*Eolide*) in the text, but on the accompanying plate it is printed *Eolis*, which name was adopted by Lamarck. Cuvier, however, afterwards latinised the name into *Eolidia* in the 'Règne Animal.' In this he has been followed by several authors, while others retain the simpler and more classical form of the original essay and of Lamarck, which may be considered also to have the priority. Dr. Fleming writes the name *Eolida*.

## EOLIS.

consider it a northern form, but our knowledge of foreign species is much too limited to allow of our pointing out their geographical distribution with any degree of certainty.

The body of *Eolis* is limaciform, in some species rather depressed and ovate, but more generally slender, and nearly linear when extended. The back is rounded, and has no vestige of cloak: the skin is thin and smooth, without spicula. The head is terminal, and scarcely distinct from the body, into which it passes imperceptibly: it is provided with four linear non-retractile tentacles, of which two are dorsal and two labial or oral. The dorsal tentacles are frequently ringed or wrinkled, rarely laminated, but in the greater number of species they are smooth, and only slightly wrinkled when contracted. The eyes are placed behind them. The oral tentacles are always simple, arising either from the margin of the lip or a little above it. A third pair of tentacles is mentioned by Cuvier, but these are merely the elongated margins of the foot. The mouth is sub-inferior, and provided with strong corneous jaws. The branchiæ are elongated, cylindrical, ovate or flattened processes, usually called papillæ, arranged in transverse rows on each side of the back, and leaving a naked space more or less visible down the centre: these rows are in some species grouped into clusters. The foot is usually nearly linear, and grooved in front, the anterior angles being in some species produced into long tentacular processes, which may occasionally be used as feelers, but analogy forbids our considering them as true tentacles. They probably assist progression. The aperture of the generative organs is placed forwards on the right side, and the anus is a little behind and above on the same side, generally near or between the branchiæ: it is very inconspicuous, and escaped the observation of Cuvier, who states that this and the generative organs are united in one common orifice.

The members of this genus are all carnivorous, feeding on zoophytes and other small marine animals. Some of them are very voracious.

The genus may be divided into four sections, characterized as follows:

Sec. 1. *Branchial papillæ numerous, depressed, and imbricated.* EOLIS proper. Type, *E. papillosa*.

In this section the body is rather broad and ovate; both pairs of tentacles shortish and smooth; and the sides of the foot a little produced and pointed.

*Spawn* consisting of numerous much-waved coils.

Sec. 2. *Branchial papillæ clustered.* FLABELLINA, Cuvier. Type, *E. coronata*.

The body is slender and rounded above; the dorsal tentacles generally ringed or wrinkled; the oral tentacles long; and the sides of the foot produced into linear processes.

*Spawn* consisting of many coils, sometimes waved.

This section may be divided into three sub-sections.

\* Dorsal tentacles ringed or laminated. Type, *E. coronata*.

\* \* Dorsal tentacles wrinkled or smooth. Type, *E. gracilis*.

\* \* \* Dorsal tentacles bulbed. Type, *E. alba*.

Sec. 3. *Branchial papillæ in transverse, generally rather distant, rows.* CAVOLINA, Bruguière. Type, *E. cingulata*.

The body is a little broader than in the last section; the dorsal tentacles smooth or wrinkled; the oral tentacles shortish; and the sides of the foot slightly produced and rounded.

*Spawn* consisting of one or, at most, two coils.

This section also contains three sub-sections.

\* Papillæ sub-linear, rows rather close. Type, *E. concinna*.

\* \* Papillæ sub-linear or slightly inflated, rows distant. Type, *E. cingulata*.

\* \* \* Papillæ large and inflated. Type, *E. tricolor*.

## EOLIS.

Sec. 4. *Branchial papillæ in a single longitudinal row on each side.* TERGIPES, Cuvier. Type, *E. despecta*.

The body is linear; the dorsal tentacles smooth, the oral tentacles very short; and the sides of the foot rounded and not produced.

*Spawn* kidney-shaped.

In sections 1 and 2 the auditory capsules contain numerous otolithes; in section 3 they contain only one otolithe each.\*

These sections run imperceptibly into each other, but in general their characters are pretty well marked. The branches of the digestive system undergo a modification in each section corresponding to the arrangement of the papillæ, as mentioned below.

As *Eolis* is the type of a family whose anatomy, from its peculiar character, has attracted some degree of attention, we purpose entering rather more into detail than we should otherwise have done: for more complete details, however, we must refer those of our readers who are interested in the subject, to the 'Anatomy of Eolis,' published by one of the authors of this work in conjunction with Dr. Dennis Embleton, in the 'Annals of Natural History,' of which the following is little more than an epitomy.

The digestive system shows in some parts great divergency from the molluscan type. The mouth opens on the inferior surface of the head, and has large fleshy lips, divided vertically and prolonged into an internal tube, within which is a circular band of strong muscles forming an inner lip, capable of being pushed forwards, and bringing with it the mouth and jaws, when the animal is in the act of seizing its prey. The mouth contains two large horny jaws, placed vertically and nearly co-extensive with the fleshy sides of the buccal mass. They are of an irregularly elliptical or ovate form (Pl. 8, figs. 17, 18, 19), a little produced on the upper anterior margin, where they are united by a strong ligament forming a hinge-like joint on which they move: below this two strong arched processes extend downwards in front, forming the cutting edges of the jaw. The tongue is strap-shaped, and covered with numerous transverse plates, armed with spines or teeth directed backwards; it is attached through its whole length to a wedge-shaped muscular mass, convex above, and extending to the entrance of the œsophagus (Pl. 7, figs. 5, 6). The muscular arrangements by which the tongue is moved in different directions, and can be thrown forwards to assist the animal in seizing and securing its prey, are beautifully adapted for the purpose, but it would lead us too much into detail to describe them here.† The lingual teeth differ in different species; in *E. papillosa* they are small and very numerous, forming transverse arched rows (fig. 7); in *E. coronata* there is one large central tooth on each plate, with denticulated sides; and in *E. alba* a central tooth only, without denticulations (figs. 11, 12). These teeth are very minute. In *E. papillosa* they are not more than one sixth part the thickness of a human hair; they are often found broken abruptly off, but never bent; and, from the circumstance of their resisting all acids but the hydrofluoric, there can be little doubt that they are siliceous. The salivary glands (fig. 6 *a*) are very small, and placed between the corneous plates and the muscular mass of the cheek. The gland is composed of

\* The capsules in the 4th section have not been examined, but as far as our observations go in the other three this distinction is without exception.

† See Hancock and Embleton's 'Anatomy of Eolis,' Ann. Nat. Hist. xv, 6.

## EOLIS.

a small cluster of roundish, yellow, irregular follicles, and frequently a smaller gland of two or three follicles is placed a little in advance. They are connected by a long slender duct, which opens into the mouth at the commencement of the cesophagus.

The cesophagus is short, with a longitudinally plicated mucous membrane, and is usually bent into the form of an S, allowing the mouth to be advanced with great facility. The stomach is a large pyriform pouch, which lies diagonally in the body (Figs. 1 *c*, 2 *d*, 3 *d*, 4 *d*), the lower end approaching to the left side: it is continued in the form of a canal, in some species wide and tapering, in others more constricted, down the median line of the back, and terminates near the posterior extremity of the body in a blind sac. From the pouch and its continuation, branches are given off in pairs, not quite symmetrical, but generally more or less alternating. These branches, after being redivided in most of the species, give off smaller tubes, which are continued into the branchial papillæ. From the upper surface of the posterior extremity of the stomach, where it is continued into the central canal, is given off a short intestine, which passes to the right side, opening in a small nipple-like anus, generally concealed among the branchiæ. The inner walls of the stomach are longitudinally plicated (fig. 13); the plications being usually continued more or less extensively through the branches. The arrangement of the lateral branches in this curious digestive apparatus varies in different sections of the genus, as given in the accompanying plates. In the first section, represented by *E. papillosa* (fig. 2), the branches bifurcate once, or sometimes twice, before they reach the extremities: in the second section, represented by *E. coronata* (fig. 4), the lateral branches have a pectinated arrangement; the more simple forms of the third and fourth sections are shown in *E. olivacea* (fig. 3), and *E. despecta* (Pl. viii, fig. 8).

The prolongations of the branches that enter into the papillæ, there undergo a considerable enlargement and change of form, and from the variety and brilliancy of their colouring, are the chief attraction of these elegant little animals. The simplest form of this peculiar organ is met with in *E. concinna*, where it is a mere dilated tube, having its walls slightly waved, and the inner surface sprinkled with darkish granules. In *E. Farrani* (Pl. 8, fig. 10) it still retains a considerable simplicity of structure, but becomes decidedly sacculated. The complexity is much increased in *E. olivacea*, in which it is produced into puckered follicles or sacculi. But in *E. papillosa* (fig. 9) it appears to attain its highest development. The central canal is there somewhat tortuous, and gives off on all sides variously-sized irregular blind sacs, which are crowded with little compound follicles. The whole of the inner surface is lined with a thickish layer of irregular vesicles or globules, filled with numerous granules. These last, when submitted to a high magnifying power, are seen to be of various sizes, transparent, rounded and nucleated. The whole of the internal surface of the gland is covered with vibratile cilia. These compound glands are evidently biliary organs, diffused throughout the several papillæ, and supplying the place of a compact liver, which is wanting in the body of these animals. The stomach and biliary organs are so intimately connected in this genus, that it is not easy to point out the limits of each; they appear to differ in different species. In *E. papillosa* the central canal is evidently a continuation of the stomach, and the plicated internal membrane is not only continuous throughout it, but also passes into the lateral branches, which thus appear to form a part of the same organ. On the other hand, we find in some species coloured granules, similar to those of the papillæ, partially lining the ramifications, as in *E. gracilis*, *E. rufibranchialis*,

## EOLIS.

*E. Northumbrica*, and others; while in *E. despecta* the central canal, all the ramifications, and the glands of the papillæ are coloured and granulated alike, implying a greater diffusion of the biliary function.

The food, after being partially digested in the stomachal pouch, is driven in detached portions through the alimentary system by the alternate contractions of the pouch and great trunks leading from it; these contractions are only of a nature to produce an oscillatory motion, which serves to promote that intimate mixture of the alimentary matters with the hepatic and other secretions, necessary to the process of digestion.

A curious organ, apparently in connexion with the digestive system, but whose functions are very imperfectly understood, is situated at the end of each papilla. It is a small ovate vesicle, which communicates with the biliary gland by means of a slender canal below, and at the opposite and narrower end opens externally through a minute aperture at the extreme apex of the papilla. (Pl. 8, figs. 9 *a*, 10 *a*, 11 *a*.) The walls of this vesicle, which are seen of an opaque white in the species with a transparent skin, consist of a strong thick layer of finely interwoven circular muscular fibres. The contents appear to be arranged in longitudinal masses. When very highly magnified these masses are found to contain long, narrow, elliptical bodies, with faint double longitudinal markings, (fig. 14 *a*), and globules of various sizes, containing either one nucleus or several small granules in their interior. These are imbedded in, and adhere to, a tenacious, obscurely granular mucus-like matter. We have frequently seen the elliptical bodies violently ejected from the terminal orifice; they are then observed to be contained in little transparent membranous bags, each holding half a dozen or more. (Pl. 8, fig. 12.) In some species these bags likewise contain other and larger flattened elliptical bodies, with a peculiar marking in the interior. (Figs. 13, 16.) Immediately after expulsion the membranous bags burst, and the contained narrow elliptical bodies becoming scattered, each shoots forth from the end first protruded, a much prolonged, slender, hair-like filament. (Fig. 14.) On one occasion we observed an individual of *E. picta*, when moving freely about, suddenly, and by a convulsive effort, eject from the points of the papillæ a minute stream of milk-white fluid, which curling upwards, mingled with the surrounding liquid and was soon lost to view. The fluid exactly resembled the contents of the ovate vesicle when forced out by pressure, and examined with a lens of low power. It appears probable that this extraordinary apparatus at the end of each papilla is an organ of defence; and from the resemblance of the minute bodies ejected to those stated to be thrown out by the *Actiniæ*, that they are stinging bodies of a similar nature.

The vascular system appears to be as complete as in any of the order. The heart is situated immediately below the skin, near the centre of the back, where it forms externally an oval swelling; it is composed of two parts, a ventricle (Pl. 8, fig. 1 *a*) and an auricle (fig. 1 *b*); these are inclosed in a very delicate pericardium of an elliptical form. The ventricle lies in front of the auricle, and the communication between them is effected by a small orifice on the under side. The ventricle is strong and muscular, and has in the interior numerous fleshy anastomosing columns. When examined after death it is somewhat pyriform, with the narrow end anterior, and having the aorta issuing from it. This vessel (fig. 1 *d*) is of considerable size, and branches may be traced from it to most of the principal organs. The auricle is much more delicate than the ventricle, and, like it, is provided with fleshy columns in the interior, only they are much finer and less numerous.

## EOLIS.

It receives three large venous trunks, two of which pass from the skin backwards to the sides of the auricle (fig. 1 *l*, *l*), and the third joins it from behind on the median line. These three trunks result from the union of veins from the skin. Two small branches also unite with the posterior trunk from below. We have not been able to trace satisfactorily the means by which the blood is conveyed from the arteries to the veins, but there can be little doubt that, in this respect, *Eolis* resembles the other nudibranchs.

The respiratory function appears to be partially specialised in the dorsal papillæ, which, usually exposing a large surface, are covered with strong and vigorous vibratile cilia; but as the blood, in its return to the heart, appears to pass almost entirely through the skin, which is thin and delicate, and also covered with cilia, there can be little doubt that the whole surface of the body assists in its aeration. The cilia of the dorsal tentacles, which are also very strong, we consider to be connected with the sense of smelling.

The central part of the nervous system consists of a series of ganglions and connecting cords (fig. 3), placed round the commencement of the œsophagus. Four large principal ganglions rest on the buccal mass immediately in front of the œsophagus: the two next the median line are much the larger, and are of an irregular ovate form; the other two are circular, and are closely attached to the outer sides of the central pair. These ganglions are connected together by three collars that pass under the œsophagus. The inner one is much shorter and thicker than the other two, and passes from the posterior margins of the lateral ganglions; the two outer ones pass from the sides of the inferior surface of the central ganglions, and lie nearly in contact with each other. One is much smaller than the other, and is placed immediately in front of it,—this is the central collar: the larger or outer collar has two small oval ganglions, which are connected together on the median line, and are usually called the buccal ganglions. The first pair of nerves, which we consider olfactory, are large, and rise from the anterior and upper surface of the central ganglions near the median line, and passing into the bases of the dorsal tentacles, swell into two well-defined oval ganglions, sending off several nerves into these organs. The second, third, fourth, and fifth pairs of nerves supply the different organs of the head, in front of the buccal mass; the sixth and following pairs to the ninth go to the skin on the sides of the body and foot. All these, excepting the first pair, arise from the anterior lateral margin of the central ganglions. The tenth and eleventh pairs, which arise from the outer side of the lateral ganglions, supply the foot and sides of the back. The twelfth pair originate from the posterior margin of the central ganglions, and go to the back on each side of the median line. Besides these other small nerves go to the skin from different parts of the central ganglions. The two small inferior buccal ganglions give off each a large nerve, which sinking into the muscles of the buccal mass, are lost there. These ganglions have attached to their inner inferior margins two small ganglions, from which the stomach and œsophagus are supplied with nerves; and imbedded in the muscles of the buccal mass there is on each side another small ganglion. These ganglions give off each a large nerve, which, passing within the outer and central collars, is united to the former by a short but rather strong branch of communication. These nerves supply the glands of the papillæ, and shortly after their origin give off minute branches to the œsophagus. The central collar gives off on each side a nerve that goes to the heart and generative organs. These details are taken from *E. papillosa*, but the nervous system differs very little in other members of the genus. In some the olfactory ganglions are round



## EO LIS.

and larger, sending off only one large nerve into the tentacles. In *E. cornata* and *E. Drummondi* the genital nerve is supplied with a small triangular ganglion at its junction with the collar.

The eye (Pl. 8, fig. 3 *b*, and fig. 7) is situated on a small elongated process at the outer side of the central ganglion immediately in front of its junction with the lateral ganglion. It is composed of a thin capsule inclosing a black pigment cup, which receives the optic nerve from below; in front of the cup, and half buried in it is a spherical lens, which is protected by a cornea a little in advance of it.

The auditory capsule is placed directly behind the eye, and is attached to the central ganglion. The otoliths are inclosed in two thin membranous bags, exceedingly delicate and transparent. In *E. papillosa* (fig. 4) and *E. coronata*, the otoliths are small, elliptical, and very numerous, but in *E. aurantiaca*, *E. olivacea*, and *E. picta* (fig. 6) there is only one large spherical otolithe.

The organs of generation (Pl. 8, fig. 2) are very voluminous, filling by far the greater portion of the cavity of the body. The intromittent organ is capable of much prolongation, and terminates in a fine, perforated, tapering point. In its contracted state it lies in front immediately within the orifice, and behind it are the female channel, and a small orifice opening on its anterior wall. The testicle (fig. 2 *c*) is a long convoluted tube situated in front of the other parts, and is connected with the intromittent organ at one end, and at the other with the oviduct. The ovarium (fig. 2 *d*) is very bulky, and, during the breeding season, almost entirely fills the posterior portion of the cavity of the body; it is deeply fissured in the dorsal median line, and divided into transverse lobes. The oviduct (fig. 2 *e*) is a delicate tube, receiving branches on each side from the various lobules, after which it dilates, and is twice or thrice bent upon itself, before it passes into the general channel. In connexion with the female parts is a large laminated gland (fig. 2 *g*, *g'*) formed of two lateral lobes, occupying the greater portion of the cavity in front of the body. It is composed of two portions, an outer homogeneous, white, semi-pellucid part, and an inner and anterior part, which is granular, opaque, and of a pale flesh colour. The ducts of the two lobes unite and form the common female channel. This gland secretes the mucus by which the mass of eggs is enveloped. In addition to the parts already described there is a small globular sack (fig. 2 *h*), which lies between the lobes of the great gland and at its posterior margin. This is the purple bag of Swammerdam, and there can be little doubt that it is a true spermatheca. A duct from this receptacle, having been joined by the duct of a small elliptical accessory gland, is united with the oviduct after the junction of the latter with the testicle, and immediately afterwards a branch of communication opens into the female channel. The duct of the spermatheca is then continued on to the small orifice before mentioned immediately within the common aperture.

From an examination of the anatomy of these organs, it would appear that impregnation is effected by the channel of the spermatheca, which, receiving the semen from another individual, retains it till required; but from the connexion of the testicle with the oviduct, each individual would also appear to have the power of self-impregnation. The ova after impregnation reach the common female channel, where they receive the gelatinous envelope previous to expulsion from the body of the parent.

# EOLIS.

## EXPLANATION OF THE PLATES.\*

### PLATE 7.

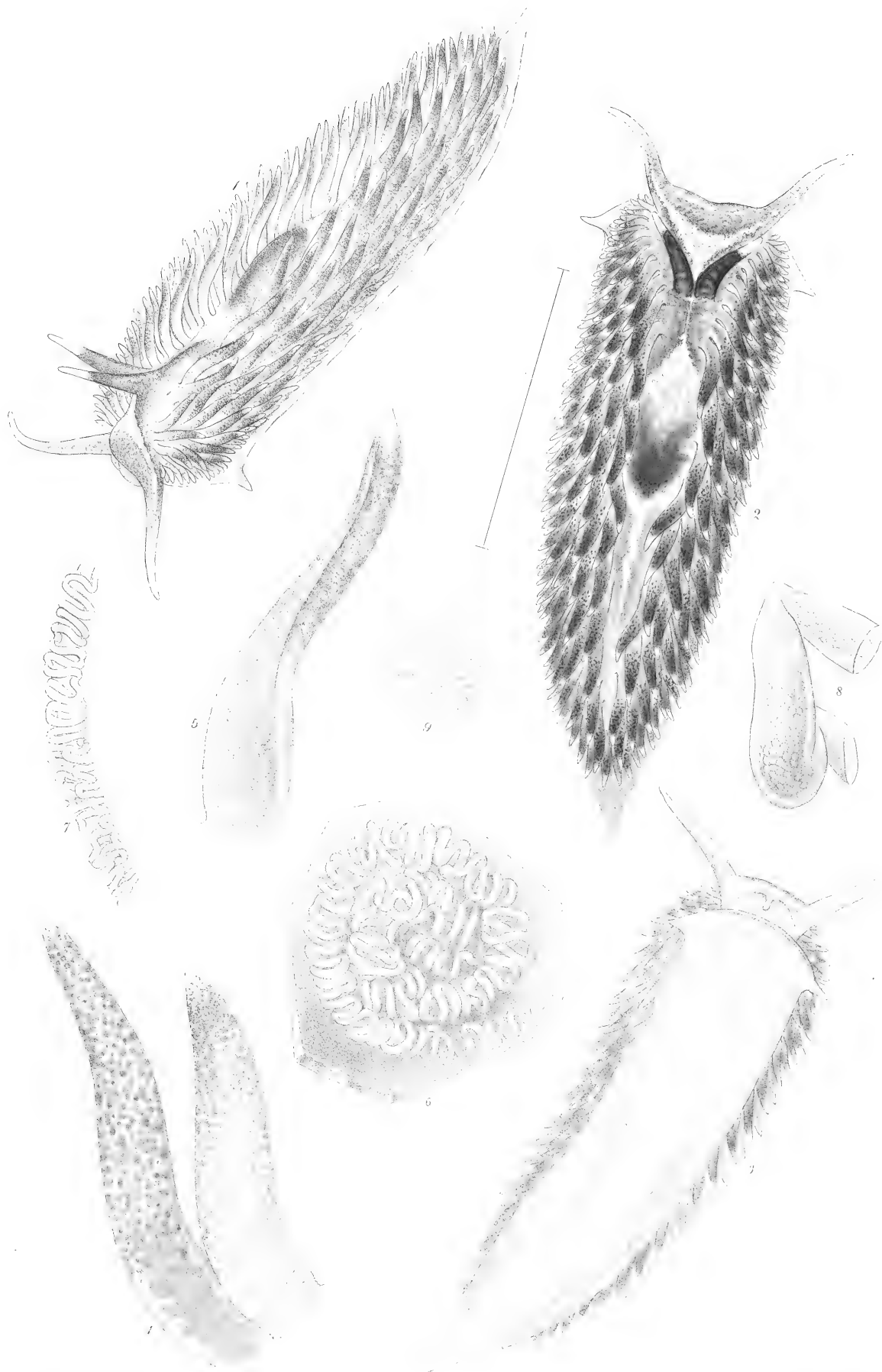
- Fig. 1. General view of the viscera of *E. papillosa* from above:—*a*, buccal mass; *b*, œsophagus; *c*, stomach; *d*, intestine; *e*, anal nipple; *f*, great central canal of the digestive system; *g, g, g*, lateral branches of the same; *h*, ventricle of the heart; *i*, auricle; *j*, testicle; *k, k*, portions of the gland for secreting the mucous envelope of the eggs; *l, l*, ovarium; *m*, cerebral ganglions, with the nerves passing off from them; *n, n*, ganglions at the base of the dorsal tentacles.
2. Digestive apparatus of *E. papillosa*, with the glands of the papillæ removed:—*a*, buccal mass; *b, b*, corneous plates of the same; *c*, œsophagus; *d*, stomach; *e*, intestine; *f*, anus; *g*, great central canal leading from the stomach; *h, h*, lateral branches leading from the same to the papillæ; *i*, ducts from the glands of the papillæ.
3. Digestive apparatus of *E. olivacea*; the letters correspond with those of the previous figure.
4. Digestive apparatus of *E. coronata*; letters as before.
5. View of the cavity of the buccal mass from above, the fulcrum being divided, and the horny plates, *a, a*, drawn apart:—*b, b*, cutting edge of the jaws; *c*, inner lip; *d*, fulcrum of the horny plates; *e*, anterior and posterior transverse muscles for closing and opening the jaws; *f*, tongue; *g, g*, wedge-shaped muscular mass, or support of the same; *h, h*, muscular cheek mass; *i*, folds of the lining membrane of the mouth; *j*, œsophagus.
6. Lateral view of the buccal cavity and cheek mass, with a horny plate removed:—*a*, salivary gland; *b*, inner lip; *c*, interior of a horny plate; *d*, cutting blade; *e*, fulcrum; *f*, anterior and posterior transverse muscles for closing and opening the jaws; *g*, flattened upper borders of the cheek mass; *h*, spiny ridge of the tongue; *i*, œsophagus.
7. Two of the transverse arched plates from the tongue of *E. papillosa*, much magnified to show the spines.
8. A portion of the tongue of *E. olivacea*.
9. Teeth from the tongue of *E. nana*.
10. Upper aspect of three plates of the same.
11. Tongue of *E. alba*.
12. Upper aspect of three plates of the same.
13. Stomach of *E. papillosa* laid open, showing the rugæ of the internal surface of the bulb, central canal, and lateral branches.

### PLATE 8.

- Fig. 1. General view of the vascular system, all the other viscera being removed:—*a*, ventricle of the heart; *b*, auricle; *c, c, c*, portions of the pericardium cut across and laid back; *d*, aorta; *e*, gastric artery; *f*, great ovarian artery; *g*, a branch of the same, supplying the posterior portion of the foot; *h*, the artery supplying the anterior portion of the organs of generation; *i*, buccal artery; *j*, arterial branches going to the channel of the mouth and anterior of the foot; *k*, buccal mass; *l, l*, large anterior veinous trunks passing from the skin to the auricle; *m*, large dorsal veinous trunk receiving veins from the skin, and passing to the auricle.
- Fig. 2. The organs of generation partially unravelled:—*a*, portion of the penis withdrawn; *b*, common female channel; *c, c*, testicle; *d*, ovarium; *e, e*, oviduct; *f*, dilated portion of the same; *g, g*, great gland for secreting the mucous envelope of the eggs; *h*, sack of

\* All the anatomical figures on these plates are from *E. papillosa*, unless otherwise stated.





Spores of *E. papillosum* 50x

Spores of *E. papillosum*

*EOLIS PAPILLOSA*

## Fam. 3, Plate 9.

### EOLIS PAPILLOSA, LINNÆUS, Sp.

*E. ovato-oblonga*, depressa, fusca, grisea, vel aurantiaca, brunneo et albo maculata; branchiis numerosis, conicis, subcompressis, in seriebus 18—24 digestis; tentaculis dorsalibus parvis subconicis; tentaculis labialibus planiusculis; angulis anterioribus pedis brevibus.

*Doris spinis mollibus hirsuta*, Baster, Op. Subs., v. 1, p. 81, pl. 10, f. 1.

*Eimax papillosus*, Linn., Syst. Nat., 12th ed., v. 1, p. 1082.

*Doris Bodoensis*, Gunn., Act. Hav., v. 10, p. 170, f. 1—13. (Copied in Encyc. Meth., pl. 82, f. 12.)

*papillosa*, Müll., Zool. Dan. Prod., p. 229. (Non Zool. Dan.)

Fab., Faun. Grœnl., p. 345.

Mont., in Linn. Trans., v. 11, p. 16, pl. 4, f. 3.

*vermigera*, Turt., Brit. Faun., p. 133.

*Eolis Cuvieri*, Lam., Anim. s. Vert., 2d ed., v. 7, p. 450, (excl. Syn. Cuv.)

Bouch. Chant., Catal. des Moll. du Boul., p. 33.

Stark, Elem. Nat. Hist., v. 2, p. 69.

*Eolida papillosa*, Flem., Brit. Anim., p. 285.

*Eolidia papillosa*, Johns., in Loud. Mag. Nat. Hist., v. 8, p. 376, f. 35.

Idem., in Ann. Nat. Hist., v. 1, p. 118.

Thompson, in Ann. Nat. Hist., v. 5, p. 89.

*Cuvieri*, Leach, Syn. Moll. Gr. Brit., p. 23, pl. 7, f. 3.

*Eolida Zetlandica*, Forbes and Goodsir, in Proc. Brit. Assoc., 1839. Athenæum, No. 618, p. 647.

*Eolidia Bodoensis*, Möller, Ind. Moll. Grœnl., p. 5.

*Eolis papillosa*, Lovén, Ind. Moll. Scand., p. 7.

Macg., Moll. Anim. Aberd., p. 192.

*Murrayana*, Idem, Moll. Anim. Aberd., p. 193.

*Lesliana*, Idem, Moll. Anim. Aberd., p. 194.

*Eolis rosea*, Ald. and Hanc., in Ann. Nat. Hist., v. 9, p. 34.

*obtusalis*, Idem, in Ann. Nat. Hist., v. 9, p. 34.

*papillosa*, For. and Hanl., Brit. Moll., v. 3, p. 590.

Dalyell, Pow. Creat., v. 2, p. 314, pl. 45, f. 23—27.

*Hab.* Among rocks and under stones from beyond low-water mark to half-tide level, frequent on nearly all our rocky coasts.

*Body* from an inch and a half to three inches long,\* ovate, depressed, rather broad

\* Mr. Cocks has sent us a drawing, "natural size," of a monster specimen found at Falmouth, measuring  $4\frac{1}{2}$  inches; and Sir J. G. Dalyell had an individual 4 inches long, "measured from the tip of the tentacula to the extremity of the tail."

## EOLIS PAPILLOSA.

in front and tapering to a fine point behind. Colour various, brown, gray, or yellowish, always more or less spotted and freckled with lilac, gray or brown, and opaque white. *Dorsal tentacles* simple, short, conical, somewhat truncated, and very contractile, generally brown with white or yellowish tips, sometimes very dark, and occasionally pink or orange coloured. *Oral tentacles* short, about the same length or a little longer than the dorsal pair, pale in colour, and set wide apart on the head, the outline of which in front is a little curved and slightly notched in the centre. Between the two pairs of tentacles there is usually a triangular yellowish white mark, formed by confluent spots of opaque matter; the angles are prolonged into lines, the basal passing into the oral tentacles, the apical, going backwards, passes between the dorsal tentacles, and reaching the swelling indicating the region of the heart, expands and forms there another triangular white spot having its base backwards; from the lateral angles of this spot the white is continued in broken lines round the sides of the heart, and uniting behind it, forms a broadish line that passes some little way down the centre of the back. From this arrangement of the white markings, the freckling produces a dark spot over the centre of the heart. These markings are not always present, and are sometimes entirely wanting: pale lines, however, bordered with dark, usually indicate their position. The back is also blotched or thickly spotted with brown and white; the dark spots becoming thicker and more intense on the borders of the white markings. *Branchiæ* very numerous, conical, stout and flattened, having a curved leaf-like outline when contracted, but capable of great extension when the animal is in action. Their colour is usually brown, from a thick freckling of that colour over the surface, intermixed with white: when the white predominates it gives the branchiæ a grayish appearance. This freckling is occasionally lilac or gray, and does not extend to the base and under surface. The tips are whitish. The central gland is yellowish-brown and much lobated, but seldom distinctly visible outside, except on the under side or towards the base. The extreme lateral papillæ are often pinkish or salmon-coloured. The papillæ are set in from eighteen to twenty closely imbricated rows of twelve to twenty-four each, sloping transversely across the sides, and leaving the centre of the back bare in front, but nearly meeting behind. The front rows extend very far forward at the sides of the head, nearly reaching to the bases of the oral tentacles; the papillæ on this part are small. *Foot* transparent white, showing through its surface the rose-coloured ovaries, rather broad, especially in front, where it is a little convex in outline and deeply grooved, extending into short angles at the sides. It terminates in a point not far behind the branchiæ, but the animal has the power of occasionally elongating and attenuating it to a considerable extent backwards.

The heart beats seventy-two to seventy-six times in a minute.

*Eolis papillosa* varies so much both in form and colour, that it has given rise to many spurious species, especially in its young state, when the number of papillæ is also fewer. It will be necessary, therefore, to particularise some of the more prominent varieties. There are two forms met with on the Northumberland coast; the one is dark brown and rather broad, with the branchiæ very numerous and stout; the other, which is usually grayish, is more slender in its proportions, and has the branchiæ and tentacles a little longer. A yellowish variety is also occasionally brought in from deeper water, the young state of which is our *E. obtusalis*. We also now consider our *E. rosea* to be the young state of a variety with rose-coloured branchiæ, having once taken a full-grown individual of that colour; this

## EOLIS PAPILLOSA.

had the papillæ much covered with opaque white. On the coasts of Devonshire and Cornwall, an orange or buff variety is more common. In Torbay we got it very large, with the branchiæ yellowish or fawn-coloured, speckled with brown and white, the back being yellowish spotted with lilac. At the Salt Rock in Salcombe Estuary we found an orange variety very abundant: the branchiæ varied from pale buff to reddish orange, spotted with white; there were very few with brown spots, and these were confined to the head and front rows of branchiæ only; the triangular mark was generally present on the head, and the back was always opaque white, occasioned by confluent spots. The colour of this species on the Cheshire coast, according to Mr. Price, is always a buff ground sprinkled with purple, and the dorsal papillæ powdered with silvery white towards the tips, but varying greatly in intensity of tint from nearly black to fawn-colour, and a uniform horny appearance. *Eolis Leshiana*, of Macgillivray, which we have no hesitation in referring to this species, has the branchiæ of a faint pinkish tint, margined and tipped with white.

There can be little doubt that this species is the '*Doris spinis mollibus hirsuta*' of Baster, described as two inches in length, and found on the coast of Holland: and as Linnæus in his '*Systema Naturæ*,' quotes Baster's figure as representing his *Limax papillosus*, we have followed Montagu, Fleming, and other British authors in considering our animal the true Linnean species, though it may not be the *Limax papillosus* of the '*Fauna Suecica*,' which it would be impossible now to identify. French authors have considered this species the *Eolis Cuvieri*, on the authority of the synonyms given by Lamarck, but an examination of Cuvier's description and figures will be sufficient to show that this is not the species described in the '*Mémoires des Mollusques*.' That species is represented with long processes at the sides of the foot, which Cuvier calls a third pair of tentacles, a character not to be found in *E. papillosa*; besides, the animal is more slender, and the tentacles and branchiæ much longer than would be the case with the latter when preserved in spirits. There are other *Eolides* coming much nearer to Cuvier's species than *E. papillosa*, but we are afraid, from the necessary imperfection of a description taken from spirit specimens in this genus, the identification of it will be very difficult, if not impossible.

This species spawns during the spring and summer months, when it may often be found plentifully under stones between tide-marks, on a rocky or shingly coast, especially where the bottom is a little muddy. It generally occurs a considerable way above low-water mark, and in situations left dry; rarely in pools, as is commonly the case with the *Eolides*. The spawn consists of a gelatinous cord, very much convoluted and waved, so that its spiral form is not readily detected at first sight. It is attached to stones in such a manner as to give it a festooned appearance when floating in the water. The eggs are scattered irregularly through the cord in groups, interrupted at intervals: each contains two or three embryos. The mass is occasionally white, but has generally a pinkish tinge, and is sometimes distinctly rose-coloured. Professor E. Forbes states that the dark variety he called *E. Zetlandica* has the spawn pure white. We have observed that the spawn of the orange variety found on the south coast is also white, but in other places the white and pinkish kinds are intermixed promiscuously, so that no character can be derived from it.

*Eolis papillosa* is pretty generally diffused through the seas of Northern Europe; and we believe has been found on the shores of North America. We have no account of its occurrence in the Mediterranean or any more southern locality.

## EOLIS PAPILLOSA.

Mr. Price, whose success in keeping marine animals is well known, informs us that *E. papillosa* does well in confinement. Its voracious habits, however, make it an unpleasant neighbour. He has observed it to attack an *Actinia gemmacea*, kept in the same vessel, and even to enter its mouth with impunity. There may be something in the mucus, which this *Eolis* exudes very copiously, injurious to other animals, or it may be that the urticating bodies from the papillæ may have some powerful effect, otherwise we should wonder at its temerity in venturing within the clutches of so powerful an antagonist.

The following interesting account of a similar attack on the Helianthoid Zoophytes has been communicated to us by Mr. Gosse.

"Last spring, when at Torquay, I kept in a large pan of sea-water many kinds of marine animals. Among these were a fine specimen of *Anthea cereus* (the variety with rose-tipped satin-green tentacles) and three of *Eolis papillosa*.

"One day I found the largest *Eolis papillosa* eating the tentacles of the *Anthea*, and when I attempted to pull it away, it held so firmly that the mouth was almost everted. Soon afterwards I again found it at the same work of destruction, and one of the smaller specimens was attacking the unfortunate *Anthea* also. The mollusks were eager and fierce, stretching forward to their prey from their points of attachment, to which they adhered only by the extremity of the foot; and frequently erecting and reversing their crowded branchiæ. On being again removed, they again returned, though from a considerable distance, so that when I looked at the pan, I almost always found one or both the *Eolides* devouring their victim, so much larger though more sluggish than themselves. The tentacles, when gnawed and torn, presently became shrivelled; some of them were torn away by the *Eolides*, and a large quantity of viscid albuminous matter was discharged in the form of irregular threads or webs attached to surrounding objects. The process of devouring went on from day to day.

"On one occasion, one of the *Eolides* attacked a magnificent *Actinia crassicornis* in the same vessel, and had eaten a hole in its side as large as a pea before I discovered the mischief."\*

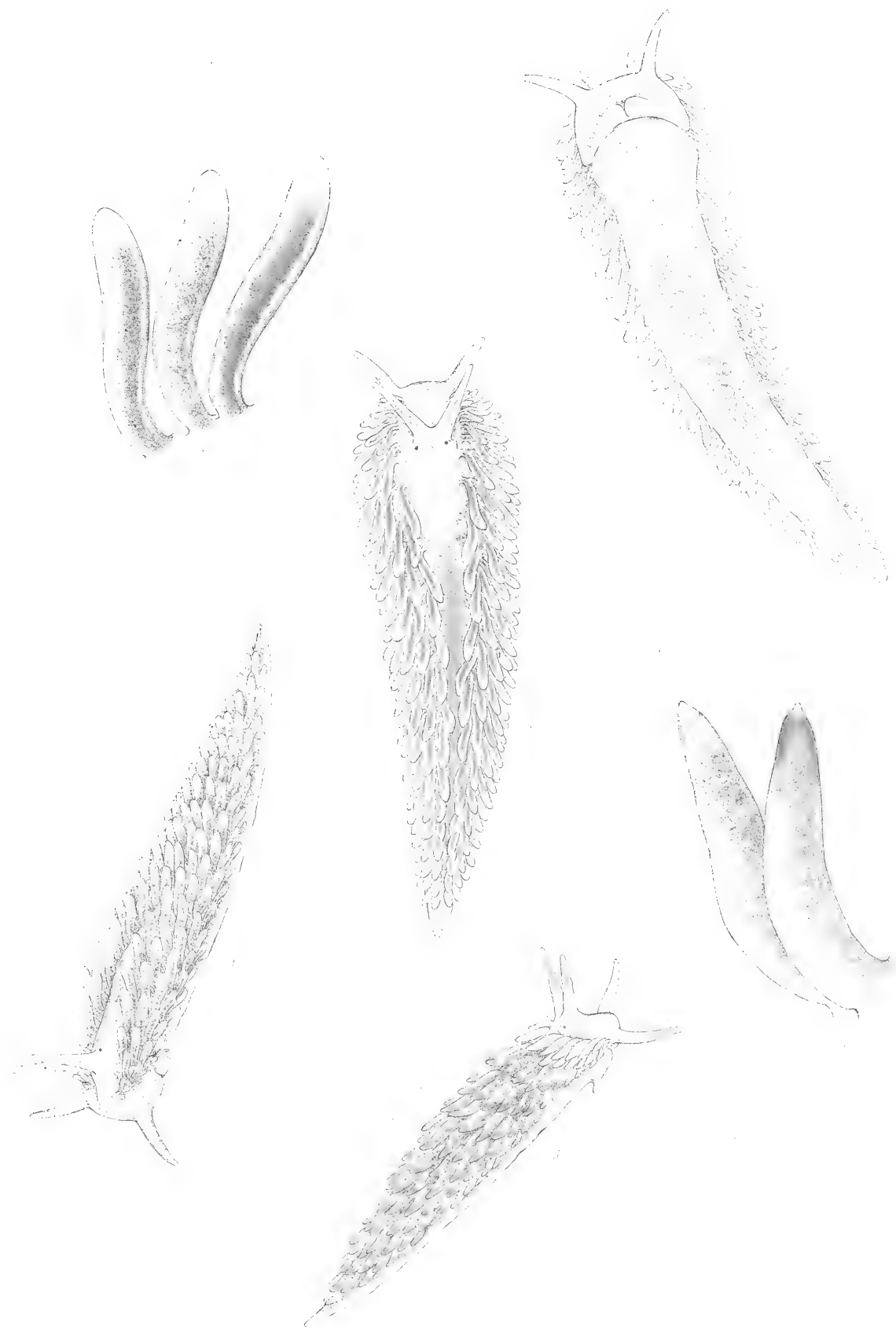
We have taken from the mouth and stomach of this species, minute specimens of the common mussel.

- Figs. 1, 2, 3. *Eolis papillosa*, different views.  
4. Two branchial papillæ, upper side.  
5. Under side of a branchial papilla.  
6. Spawn.  
7. A portion of the same.  
8. The same, exhibiting ova.  
9. A few of the ova much enlarged.

\* This account has since been published in the very interesting 'Rambles of a Naturalist on the Devonshire Coast,' p. 15.







## Fam. 3, Plate 10.

*Figs. 1 to 4.*

### EO LIS PEACHII, ALDER AND HANCOCK.

*E. oblonga*, sub-depressa, lutescens vel carnea; branchiis numerosis, sub-clavatis, obtusis, luteo-fuscis, apicibus albis, in seriebus 20 digestis; tentaculis dorsalibus longiusculis, lævibus; tentaculis labialibus brevioribus; capite lunato, lateribus productis; angulis anterioribus pedis obtusis.

*Eolis Peachii*, Ald. and Hanc., in Ann. Nat. Hist., 2d Ser. v. 1, p. 191.

For. and Hanl., Brit. Moll., v. 3, p. 591.

*Hab.* Fowey Harbour, Cornwall, *C. W. Peach* and *J. A. Cullercoats*, *J. A.*

*Body* about three quarters of an inch long, broadish in front, and tapering gradually to a point behind; buff-coloured, deepening to a rosy flesh-colour on the back, from the ovary appearing through. *Dorsal tentacles* rather long, linear, smooth, approximating. *Oral tentacles* about two thirds the length of the dorsal pair, set rather wide apart on the head. They originate from the margin of the lip, but a ridge passes from them upwards on the external side, giving them the appearance as if cemented to the upper surface of the lip. Both pairs are buff-coloured. *Head* very broad, as wide as the foot, semicircular or lunate, produced at the sides, and terminating posteriorly in a blunt point on each side. *Branchiæ* very numerous, slightly clavate, obtuse at the apex; the central gland yellowish brown or fawn-coloured, a little uneven in outline, and granulated; apices white. The papillæ are set in upwards of twenty very dense rows, extending close to the tail behind, and running along the sides of the head in front, so as nearly to surround the dorsal tentacles: the rows contain about eight or nine papillæ each. *Foot* pale buff, of a rosy appearance in the centre when the animal is filled with spawn: it is rather broad in front, tapering gradually to a blunt point behind.

This well-marked species was first met with in Fowey Harbour, Cornwall, where it was dredged by Mr. Peach, and subsequently by ourselves. We afterwards got a single specimen at Cullercoats, from a zoophyte brought in by the fishing-boats.

The Fowey specimens, which were taken at the end of May, were filled with mature spawn.

The peculiar form of the head in *E. Peachii*, similar to what is found in *E. nana*, but more strongly marked, and the agreement of these two species in most of their other characters, including the tongue, induce us to think they ought to form a distinct section of the genus, intermediate, in some respects, between our first and third sections.

Figs. 1, 2, 3. *Eolis Peachii*, different views.

4. Three of the branchial papillæ, much enlarged.



### Fam. 3, Plate 10.

*Figs. 5 and 6.*

#### EOLIS ALDERI, Cocks.

*E. griseo-albida*, depressa; branchiis subconicis, leviter depressis, seriebus 12—14 crebre digestis, ordinibus 2 vel 3 anterioribus albis, reliquis griseo-fuscis, apicibus flavis; tentaculis flavis; angulis anterioribus pedis paululum productis.

*Eolis Alderi*, Cocks, in *Naturalist*, v. 2, p. 1, pl. 1, f. 1.

*Hab.* In pools between tide-marks, Gwyllyn Vase, Falmouth, *W. P. Cocks, Esq.*

*Body* five to seven tenths of an inch in length, transparent white, with opaque white spots. *Dorsal tentacles* linear, nearly smooth or a little wrinkled, approximating, of moderate length and bright yellow. *Oral tentacles* a little longer than the dorsal ones, white tipped with yellow, set rather above the margin of the head. *Branchiæ* very numerous, sub-conical, a little flattened, and tapering gradually towards the top; arranged in from twelve to fourteen dense rows, nearly covering the whole of the back, extending round the sides of the head in front, and reaching very nearly to the tail behind. The first two, or sometimes three, rows are opaque white, the remainder are gray marbled with pale purplish brown, and profusely spotted with white: the apices are yellow or pale orange with the extreme tips pale. *Foot* transparent white, a little rounded in front, and produced into short angles at the sides; the posterior extremity is extended into a fine point.

For the knowledge of this species we are indebted to our friend Mr. W. P. Cocks, who found it very abundant at Falmouth in the summer of 1848. During that year, he informs us that he got nearly seventy specimens. It was scarce in 1849, and from that time to the present he has not seen a single specimen. It comes very near to our *E. glauca*, but Mr. Cocks, who has had the opportunity of studying both species in a living state, considers it quite distinct. The white ruff, formed by the first two rows of papillæ, he assures us is a permanent and good character in this species, besides that it is never more than half the size of *E. glauca* in the adult state, and the colour is also different. Unlike *E. glauca*, this is a very active and restless creature, erecting its branchiæ and shewing much irritability when disturbed. It spawned profusely in confinement. The ova, which are deposited in July and August, are contained in a pellucid membrane of a cylindrical form, attached by the lower surface. From the drawings we have been favored with, it appears to form a much waved spiral, with a single row of eggs sparingly distributed through it. In this character the spawn differs from that of any other British *Eolis*. Mr. Gosse has observed a similar arrangement of the ova in *Antiopa cristata*.

The specimen of this *Eolis* from which our drawing was taken is the only one that reached us in a living state.

Fig. 5. *Eolis Alderi*, side view.

6. Two of the branchial papillæ, much enlarged.









## Fam. 3, Plate 11.

### EOLIS GLAUCA, ALDER and HANCOCK.

*E. sub-depressa*, elongata, rufescens: branchiis vermicularibus sub-conicis, sub-compressis, glaucis, fusco et albo punctatis; in seriebus 14 densè digestis: tentaculis sub-linearibus, lævibus: angulis anterioribus pedis paululum expansis.

*Eolis glauca*, Ald. and Hanc., in Ann. Nat. Hist. v. 16, p. 314.

*Hab.* Dredged off Berry Head, in Torbay.

*Body* upwards of an inch and three quarters long, rather depressed and elongated, tapering to a fine point behind; pale red, more intense towards the head. *Dorsal tentacles* approximating at the base, and spreading above, moderately long, rather slender and tapering, smooth, of a full red, the tips whitish and obtuse. The eyes are small, and placed close behind them. *Oral tentacles* set rather wide apart, and about the same length as the dorsal pair, their bases forming the sides of the head; white with a reddish tinge on the upper part, especially towards the base, and minutely speckled with opaque red. *Branchiæ* very numerous, rather stout, slightly depressed, vermicular, and tapering a good deal towards the top; of a pale sage-green colour, speckled with brown and opaque hoary white, and frequently with a reddish tinge near the apex; the extreme tips pale. They extend forwards round the base of the dorsal tentacles, and are arranged in about fourteen transverse rows down the sides of the back, leaving a bare space in the middle for about half way down. The anterior rows contain ten or twelve papillæ each, and as they approach the foot, each of these rows is subdivided into two or three, forming a close series of papillæ on the lower part of the body: above there is a short space intervening between each row. The posterior rows are set in close single series to near the tail, which extends a short way behind them, and is generally produced into a fine linear point. *Foot* pale, slightly tinted with yellow, the spawn appearing of a flesh colour through the centre: it is broadish, arched in front, slit transversely, and extended at the sides into tentacular points.

A single specimen of this fine species was procured by the dredge off Berry Head, in Torbay, in the summer of 1845. It lived with us some time, and showed but little activity.

*Eolis glauca* is perfectly distinct from any other species we are acquainted with, and, with the exception of *E. papillosa*, is the largest of the British Eolides. It is at once distinguished from *E. papillosa* by its more slender form, and the clustering of the anterior branchiæ, but more especially by the curious vermicular form of these appendages, which are capable of a considerable degree of motion in an undulating manner.

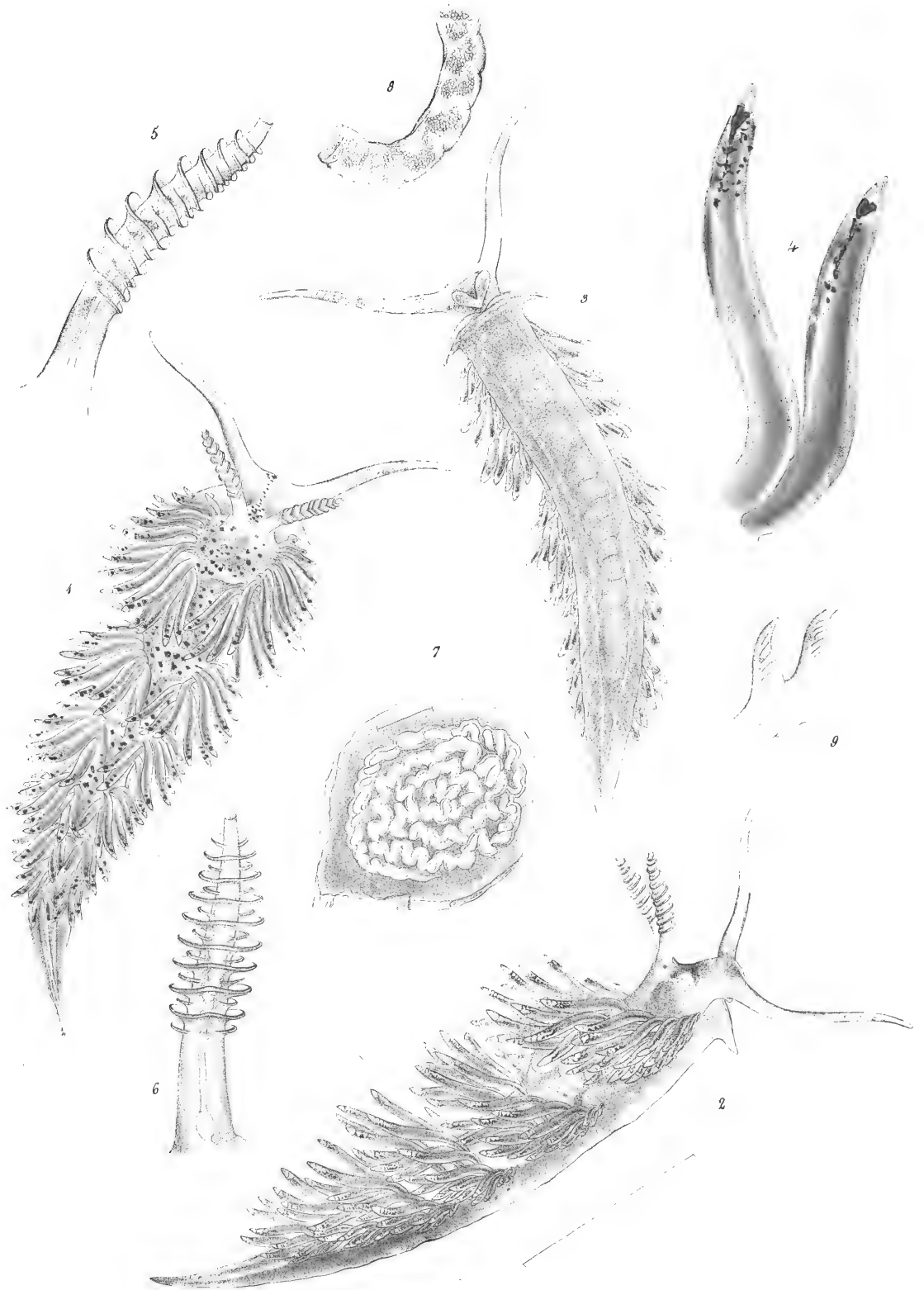
EOLIS GLAUCA.

The *Doris vermigera* of Turton (British Fauna, p. 133,) might be considered to belong to this species, with which it sufficiently agrees, did it not equally agree with *E. papillosa*, which common species Dr. Turton was much more likely to meet with on the Mumble Rocks, than one of so great rarity as the present, whose habitat is probably always beyond low-water mark.

Figs. 1, 2, 3. *Eolis glauca*, different views.

4. Two of the papillæ more highly magnified.





A. B. del.

EQUISETUM CORONATUM

C. H. Hallman del. s. Patent Lithotint.

### Fam. 3, Plate 12.

#### EOLIS CORONATA, FORBES.

*E. gracilis*, albida: branchiis oblongis, sub-linearibus, rubris, cœruleo-tinctis, apicibus albis, in fasciculis 6-7, digestis: tentaculis dorsalibus valdè annulatis, annulis 7-8: angulis anterioribus pedis productis.

*Eolida coronata*, Forbes in Athenæum for 1839, No. 618, p. 647.

*Hab.* Under loose stones and rocks between high and low water mark. Shetland, *Professor E. Forbes*. Whitley, Cullercoats, and Newbiggin, Northumberland. Marsden, Durham. Rothesay Bay, Isle of Bute. Dublin Bay and Malahide, Ireland.

*Body* about an inch long, slender, nearly linear and tapering to a fine point, of a transparent watery white, tinged with rose-colour and buff, the latter from the viscera shining through. Immediately behind the dorsal tentacles there is a large longitudinal stain of rose-colour, caused by the œsophagus, and in front of them is a lozenge-shaped spot, of opake white or blue, from which a streak of the same passes to the anterior margin of the head, and another streak passes backwards between the tentacles, and terminates a short way behind them. There is likewise a white streak on the ridge of the tail, and the upper surface of the body is sprinkled over with irregular faint spots, of opake white, not unfrequently tinged with blue. *Dorsal tentacles* fawn-coloured, with a pale sulphur-yellow streak in front, subclavate, having seven or eight wide membranous rings, and incomplete intermediate ones, which gives them a peculiarly elegant appearance; points truncated. They spread gradually apart above and approximate at the base, and are not much inclined forwards. The portion of the body bearing these tentacles is rather elevated. *Oral tentacles* much longer than the dorsal ones, tapering, white, tinged with pink or blue, and generally held in a gracefully curved position: they gradually enlarge at the base, so as to form a continuous outline with the head. Their tips have an opake white streak. *Branchiæ* elliptic-oblong, nearly linear, cylindrical, set in six or seven clusters down each side of the back. Their central vessel is of a deep crimson, varying occasionally to brick red, orange, or more rarely pale rose-red or flesh colour, with the extremities darker; the sheaths always reflecting more or less of a bright ultramarine blue, which generally forms an oblong blotch or streak in front. The apices have an imperfect opake white ring, expanded in front and prolonged into a streak which passes a little way down the papillæ. From above, the apex appears to be perforated; an appearance caused by the white ring being confined to the surface, and the central part transparent. The first cluster of branchiæ, which forms with the opposite one a kind of ruff round the neck, consists, in fine full-grown specimens, of twenty or thirty papillæ, set in transverse rows of five or six each, rather long on the back and diminishing towards the sides. The second cluster, divided from the first by a short space, is less numerous, and the rest become gradually less in number and size, sometimes nearly coalescing. *Foot* slender, extending beyond the branchiæ behind and tapering to a fine point, the anterior margin is slit transversely, and the upper laminæ notched in the centre; the lateral angles produced at the sides and curved backwards.

This fine species—one of the most beautiful of its tribe—occasionally reaches an inch

## EOLIS CORONATA.

and a half in length. It may be distinguished by the brilliant blue which is always more or less present on the branchiæ, sometimes only giving them a faint tinge, at others forming a streak down the front of each papilla; and sometimes a very beautiful variety occurs with the blue nearly covering their whole surface. The branchiæ are variable in number and liable to fall off. An entire clump is sometimes wanting.

This is a very active animal, and whilst gliding forward its tentacles are in continual motion, bending gracefully in all directions. Both pairs appear to be endowed with great sensibility, contracting themselves and suddenly shrinking backwards on coming in contact with anything. Sometimes they will do this without apparent cause. The branchiæ, too, usually partake of this restless motion, and are capable of great extension and contraction at the will of the animal. We have had several opportunities of noticing the carnivorous propensities of this species, which is certainly not the least voracious of its tribe. After having been for a day or two without food, they will even devour their own kind, the weaker falling a sacrifice to the cravings of the stronger. Large individuals will content themselves with plucking off each other's papillæ; but should a smaller specimen be within reach, it is most mercilessly attacked, the more powerful animal laying hold of any part of the weaker that may happen to be nearest. The tail, however, is generally first seized, and fierce and determined is the onset. The devourer raises and shakes his papillæ in the manner that the porcupine shakes its quills when irritated, and then, laying back the dorsal tentacles and curling up the oral ones, fixes the protruded mouth and jaws upon his prey, when, with a convulsive shrinking up of the body, morsel after morsel is appropriated. In this manner it is not uncommon to see an individual entirely devour another, half its own size. We have also seen this species feed upon a *Lucernaria*.

*Eolis coronata* spawns most abundantly in June, at which period it is rather plentiful among the rocks at Whitby and Cullercoats; patches of spawn, however, are not unfrequently found in July, and occasionally in August. The spawn is attached to the underside of stones, and is disposed in a close-set spiral coil of four volutions, consisting of a waved gelatinous thread, with yellowish imbedded ova.

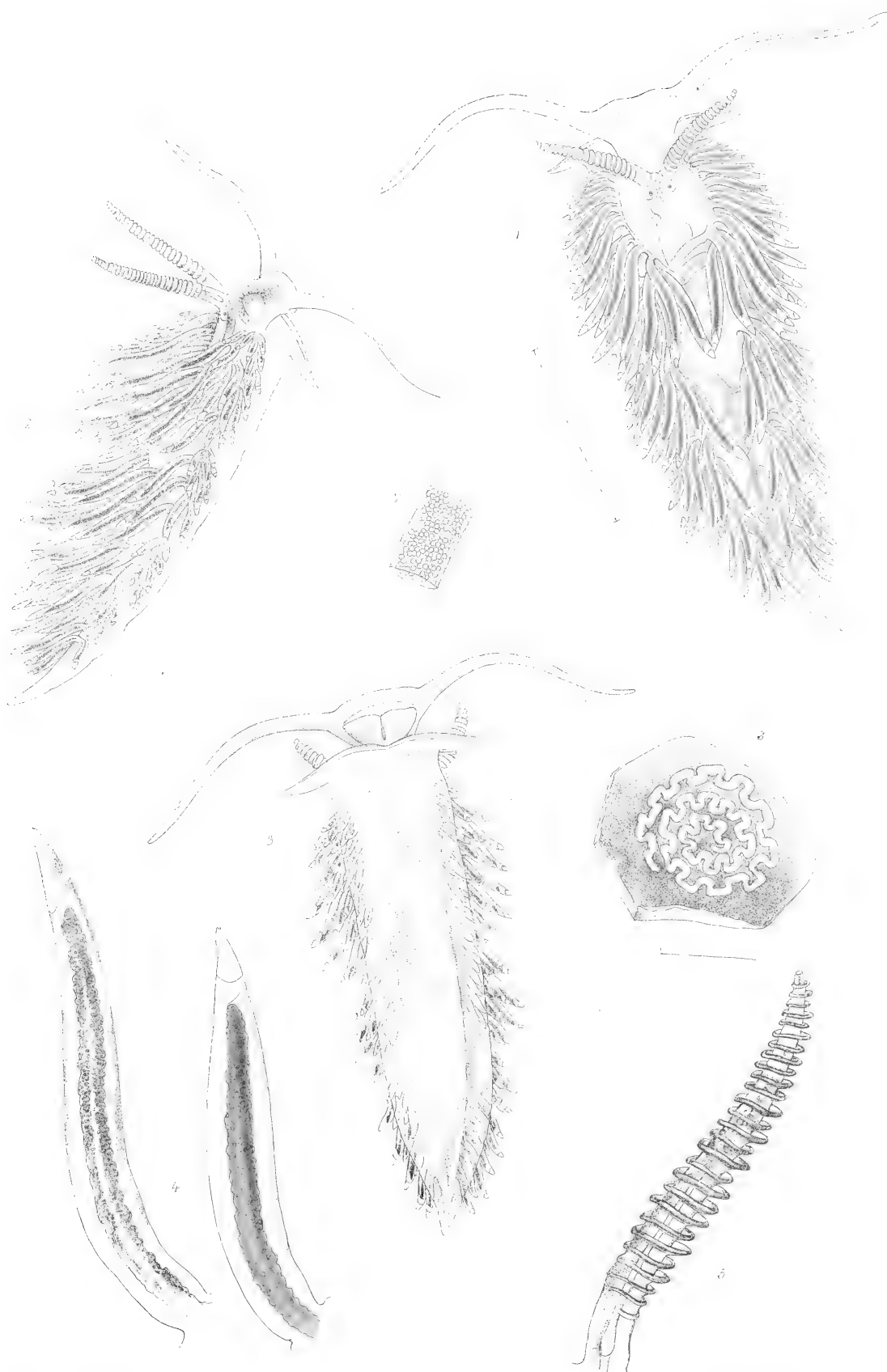
This species was first discovered by Professor E. Forbes in Shetland, and we have since found it in several places; principally on the northern shores of our islands. On the Northumberland coast it is one of the most common species, and in Malahide Bay we found an orange variety of it in considerable numbers on large *Laminariæ* and sponges dredged in shallow water.

We suspect that the *Eolis peregrina*, mentioned by Dr. Grant as having been found in the Frith of Forth; is this species, which somewhat resembles that of Cavolini in the colour of the branchiæ, but not in their arrangement. We see no good reason for believing that the true *E. peregrina* has ever been found in this country.

The pulsations of the heart are about sixty-five in a minute.

- Fig. 1, 3. Back and foot views of *Eolis coronata*.  
2. Side view of the blue variety.  
4. Two of the papillæ more highly magnified.  
5, 6. Dorsal tentacles.  
7. Spawn.  
8. A portion of the same more highly magnified.  
9. Two teeth from the tongue highly magnified.





A Hancock del H Holmes lithotint

C Hummel's Parent

## EOIIS DRUMMONDII.



## Fam. 3, Plate 13.

### EOLIS DRUMMONDI, THOMPSON.

*E. albida*, branchiis elongatis, sub-linearibus, rufescentibus, apicibus albis, in fasciculis 4-6 digestis: tentaculis dorsalibus densè annulatis, annulis 20-30: tentaculis labialibus longis: angulis anterioribus pedis valdè productis, acuminatis.

*Eolidia rufibranchialis*, Thompson, in Ann. Nat. Hist. v. 5, p. 89.

*Eolis Drummondi*, Idem in Report Brit. Assoc. for 1843, p. 250.

Var. *Eolis tenuibranchialis* (?), Ald. and Hanc. in Ann. Nat. Hist. v. 16, p. 315?

*Hab.* Under stones between tide-marks, and in shallow water: not uncommon in the north of Ireland, and on the Western Coasts of Scotland and England. Belfast Lough, plentiful, *Dr. Drummond*, and *W. Thompson, Esq.* Rothesay, Isle of Bute; Lamash, Isle of Arran; Ardrossan and Saltcoats, Ayrshire; frequent, *J. A. Birkenhead, J. Price, Esq.* Dredged near South-Sea Castle, Portsmouth, *Capt. James, R.N.*

*Body* from an inch to an inch and a half in length, rather broad, and spreading a little at the sides; of a transparent watery white, with a shade of yellow or flesh-colour, becoming deeper towards the head, which is large and generally of a rosy flesh-colour, with a little opaque white immediately in front of the dorsal tentacles, and a delicate streak of the same passing between them; there are also a few spots of opaque white over the heart. *Dorsal tentacles* approximating at the base, long and linear, but capable of great contraction, of a rosy fawn colour with opaque white or yellowish tips, and a streak of the same passing a little way down in front: they are covered to near the base with numerous rings,—about twenty or thirty in number—some of which are narrower than the rest. *Oral tentacles* very long, sometimes in young individuals extending nearly half the length of the body; broad at the base, and tapering to a point; tinged with the same colour as the head, with usually a streak of opaque white towards the tip. *Branchiæ* numerous, long, linear, a little broader in the middle, and tapering to a point at the apex; set down the sides of the back in from four to six clumps: the first large, and generally containing thirty or forty papillæ, arranged in seven transverse rows, the largest containing about six each; the remaining clumps grow gradually less numerous, and the last comes very near to the tail, so that the papillæ extend beyond it when the animal is at rest. They are of a reddish brown colour, varying to dull red, brown drab, and yellowish brown in different individuals; the coloured portion is slightly granular, and forms a rather narrow central line with undulating edges, the transparent white sheath appearing of equal breadth to it on each side. There is a ring of opaque white near the top, which extends down into an angle in front, and is occasionally interrupted behind. The tips are transparent. *Foot* broad and thin, transparent white, the front angles produced into long, pointed tentacular processes. It is strongly grooved, and doubly arched in front, and tapers rather abruptly to a point beyond the branchiæ posteriorly.

## EOLIS DRUMMONDI.

This species was first observed by Mr. Thompson, of Belfast, on the north coast of Ireland, and afterwards dredged in considerable abundance by Dr. Drummond at Bangor, county Down. Mr. Thompson published it originally in the fifth volume of the 'Annals of Natural History,' under the name of *Eolidia rufibranchialis*, to which species most of the Eolides with red branchiæ were at that time referred; but, on a subsequent examination of the specimens in spirits, together with the accurate description of Dr. Drummond, kindly forwarded to us by Mr. Thompson, we were convinced that it was a distinct species, and the latter gentleman consequently gave it the name of *Drummondi*, in his Report of the Fauna of Ireland furnished to the British Association. We have since met with it plentifully on the west coast of Scotland, where it appears to be the most common species, spawning freely in the months of May and June at and below half-tide level. The spawn is attached to the under side of stones, and consists of three or four volutions, beautifully disposed in angular waved lines, assuming the appearance of a regular Greek pattern. The ova lie six or eight abreast.

*Eolis Drummondi* is one of the largest British species of the section to which it belongs, and is much broader in proportion to its length than most of its allies. It is very active, and particularly light and buoyant, detaching itself from its hold on the slightest disturbance, and erecting its papillæ in a very graceful manner; these it has the power of extending to a great length when annoyed.

Like the rest of its tribe, *Eolis Drummondi* is extremely voracious, devouring the smaller species that come in its way without mercy, nor sparing even its own weaker brethren. Having put three individuals of this species into a glass of sea-water together one evening, the next morning we found the two stronger ones finishing a repast upon their unfortunate companion, the head and jaws of which only remained to tell the tale.

An *Eolis* we found in Torbay, and described in the 'Annals of Natural History' under the name of *E. tenuibranchialis*, we are now inclined to think may have been a variety of *E. Drummondi* in a sickly state. Our *Eolis curta* also, founded upon a single specimen from Cullercoats, and which we have since met with sparingly at Scarborough, may also possibly turn out to be an immature variety of this species.

Figs. 1, 2, 3. *Eolis Drummondi*, different views.

4. Two of the branchiæ more highly magnified.
5. A tentacle, also very highly magnified.
6. The spawn.
7. A portion of the same more highly magnified.





A Hancock del H.Holmes lithourt.

C.Hullmandel's Patent

EOLIS RUFIBRANCHIALIS

## Fam. 3, Plate 14.

### EOLIS RUFIBRANCHIALIS, JOHNSTON.

*E. gracilis*, elongata, alba : branchiis linearibus, coccineis, apicibus albis, in fasciculis 6-7 indistinctis digestis : tentaculis dorsalibus corrugatis : angulis anterioribus pedis curtis.

*Eolidia rufibranchialis*, Johns., in Loud. Mag. Nat. Hist. v. 5, p. 428.

Idem, in Ann. Nat. Hist. v. 1, p. 121.

*Eolidia Embletoni*, Idem, in Loud. Mag. Nat. Hist. v. 8, p. 379.

*Hab.* Under stones in pools at low-water mark, and in shallow water. Berwick Bay, *Dr. Johnston*. Whitley and Cullercoats, rather rare. Lamslash Bay, *Rev. D. Landsborough*.

*Body* about an inch long, very slender, and tapering to an exceedingly fine point ; transparent watery white, appearing yellowish in the centre, from the viscera shining through ; an opaque white line passes along the ridge of the back from the heart to the end of the tail. *Dorsal tentacles* moderately long, tapering, wrinkled transversely, and set at a little distance apart ; of a yellowish white, sometimes tinged with rose colour, and having an opaque line of white on the upper part of the posterior surface. *Oral tentacles* of about an equal length with the dorsal pair, transparent white, with an opaque white central line ; rather depressed and separated by the rounded outline of the head. *Branchiæ* rather short, slender, nearly linear ; the central vessel scarlet or rose red, with the margins much undulating ; the sheath transparent, and having a slender opaque white ring near the apex. They are set in six or seven ill-defined clusters on the sides of the back ; and are arranged in transverse rows, the largest containing about four papillæ each : in the first cluster there are six or seven rows ; in the next, four ; and two or three each in the others. *Foot* very transparent, linear, and extending considerably beyond the branchiæ into a very slender point behind ; in front the margin is slightly bilobed, slit transversely, and a little produced at the sides, ending in small points.

This is one of the most slender and delicate forms of the genus. It is met with on the rocks near low-water mark in April, May, and June, when it has attained its full growth, and is spawning. The spawn is attached to the under surface of stones in pools, and resembles that of *E. coronata*, but is more openly coiled, and the band or thread of eggs is less undulated. In August and September, the young are found considerably advanced.

This beautiful species has been much misunderstood. We agree with Dr. Johnston in uniting his *E. Embletoni* and *E. rufibranchialis*, yet we suspect that he has included more

# EOLIS RUFIBRANCHIALIS.

than one species under the latter name in his 'Memoirs of Scottish Mollusca Nudibranchia,' and the same course has been followed by other authors. The animal now figured agrees with Dr. Johnston's description, and has been recognised by him as the type of his species we therefore give it with confidence as the true *Eolis rufibranchialis*.

- Figs. 1, 2, 3. *Eolis rufibranchialis*, in different positions.  
4. Two of the papillæ more highly magnified.  
5. A tentacle much magnified.







## Fam. 3, Plate 15.

### EOLIS PUNCTATA, ALDER and HANCOCK.

*E. carneo-lutescens*, maculis albis undique aspersa: branchiis oblongis, acutis, flavido-fuscis, maculis albis, in fasciculis 5-6 digestis; tentaculis dorsalibus obliquè laminatis; tentaculis labialibus longis: angulis anterioribus pedis valdè productis.

*Eolis punctata*, Ald. and Hanc. in Ann. Nat. Hist. v. 16, p. 315.

*Hab.* In rather deep water, Torbay.

*Body* about an inch long, nearly linear, pellucid yellowish white, tinged with rose-colour about the head and shoulders, and of a buffish hue behind, from the viscera appearing through; the whole spotted over with rather large, distant, opaque white spots. *Dorsal tentacles* slightly conical, tapering towards the top and truncated, having twelve or thirteen very oblique laminæ and imperfect intermediate ones: the laminæ slope downwards behind as in the *Dorididæ*, and are interrupted in front, exposing the shaft, as is also the case in several of that family; they are united behind to an elevated zigzag ridge. The colour of the tentacles is a dull yellow, opaque and paler towards the top; they stand apart above and approach towards the base, inclining very little forwards. *Oral tentacles* twice the length of the dorsal ones, and tapering, their bases forming the sides of the head; pellucid white, slightly tinged with rose-colour, and having an opaque yellowish white streak towards the tips. *Branchiæ* in six or seven clusters; the anterior pair the largest, and divided from the second pair by a considerable naked space, in which the heart is situated. The first cluster has three principal rows, containing altogether between thirty and forty papillæ; those next the foot small and closely set. The second cluster has about half as many papillæ; the remaining clusters are small and nearly confluent, approaching very near to the tail. The papillæ are elliptic oblong, tapering above, and of a dark brownish flesh-colour, spotted with white in the same manner as the body; the spots becoming smaller and clustered towards the apex, which is transparent. *Foot* with the sides nearly parallel, the posterior extremity rather abruptly tapering, and terminating a short way behind the branchiæ; the front deeply bilobed and extended into long tentacular processes, curved backwards at the sides, the outline having a bow-like appearance; the margin is transversely slit. Colour transparent yellowish white or buff, with a tinge of flesh-colour; the upper part spotted with white.

This is another of the novelties that we have obtained in Torbay, where it was dredged in deepish water off Berry Head. In general appearance it somewhat resembles *E. Drummondii*, but is at once distinguished from this and all its congeners by the dorsal tentacles, which are laminated in oblique folds like those of *Doris*. It is also peculiar from the conspicuous white spots that cover it on all sides.

This interesting animal lived with us for some time, and afforded an opportunity of studying its habits. It is a very active creature, moving about in all directions, and

## EOLIS PUNCTATA.

frequently swimming inverted on the surface. It would appear also to be rather unscrupulous in its voracity, as in one instance we suspect it to have made a repast of its own spawn; and on other occasions it devoured a *Doto coronata*, a portion of an *Eolis coronata*, and several individuals of *E. olivacea*. When it seized its prey the body shrunk up, the papillæ became agitated and twitched in a peculiar manner, the tentacles were thrown back, the lips retracted, and the mouth advancing, in an instant the object of attack was forcibly drawn within reach of its formidable jaws; at short intervals the attack was renewed; the animal, however, all the while keeping its hold until the whole was despatched. On the first seizure of its prey, this species generally emits a sound resembling the click of a watch, or, perhaps more nearly, the sound produced by pressing the edges of the finger and thumb nails together, and then letting them slip. The sound is generally repeated on each renewal of the attack, and is frequently produced at other times. We have heard it on several occasions when the animal was perfectly quiescent, and again when it was moving about, probably in search of food. The sound, which is never emitted more than once at a time, and generally at considerable intervals, is sufficiently loud to be heard at some little distance. From the nature of the sound we are quite inclined to agree in opinion with Dr. Grant, who was the first to notice that these creatures have the power of emitting sounds, that it is produced by the cutting edges of the corneous jaws, and indeed it would be difficult to understand by what other means it could be effected.

Whilst in confinement, this species deposited three patches of spawn at different times. The eggs are white, and are contained in a wide, undulating gelatinous cord, coiled about three times. One of the patches which was deposited on the 29th or 30th of June, was hatched on the 9th of July. The larvæ very closely resemble those of *E. coronata*.

Fig. 1, 2, 3. Different views of *Eolis punctata*.

4. Two of the papillæ highly magnified.

5, 6, 7. Side, front, and back view of a dorsal tentacle, much increased in size.

8. Spawn.

9. A portion of the same more magnified.





A Hancock del W. Wing lith

C. Hullmandel's Patent Lithogr

*EOLIS LINEATA.*

## Fam. 3, Plate 16.

### EOLIS LINEATA, LOVÉN.

*E. gracilis*, alba, pellucida, lineis tribus longitudinalibus, albis opacis; branchiis linearibus, roseis albo-lineatis, fasciculis 4—5 digestis; tentaculis dorsalibus longiusculis, subcorrugatis, albis postice lineâ opacâ; angulis anterioribus pedis productis.

*Eolis lineata*, Lovén, Ind. Moll. Scand., p. 8.

Ald. and Hanc. in Ann. Nat. Hist., v. 18, p. 294.

*Hab.* Among rocks near low-water mark, Saltcoats, Ayrshire, *Rev. D. Landsborough, junr.*  
Dredged in shallow water, Douglas, Isle of Man, *J. A.*

*Body* an inch long, slender, transparent white, tinged with yellow or flesh-colour, with three opaque white lines, extending along the body to the tail; one of these runs along the top of the back, bifurcating in front, and extending into the oral tentacles; the other two occupy the sides of the body, terminating anteriorly below the first cluster of papillæ. *Dorsal tentacles* approximating at the base, rather long, linear, slightly tapering, and faintly wrinkled, transparent yellowish white, with a line of opaque white down the back of each. *Oral tentacles* slightly exceeding the dorsal pair in length, tapering, transparent, with a longitudinal opaque white line: their bases form the sides of the head. *Branchiæ* nearly linear, tapering a little above. The central vessel, which nearly fills the sheaths, is of a bright carmine colour, and slightly granular. There is an opaque white ring near the tip, which is prolonged into a line down the front of each papilla. The papillæ form five clusters on each side of the back, the first and second distinct, the rest coalescing: the first cluster contains sixteen or eighteen papillæ, the others are smaller, decreasing in size as they approach the tail. *Foot* linear, grooved in front, and produced into tentacular processes of moderate length at the sides. The colour is transparent white, tinged of a pinkish hue, from the viscera appearing through.

It is rather remarkable, that this species should have been described at nearly the same time and under the same name by Professor Lovén and ourselves, in the distant localities of Sweden and Britain. That Professor Lovén's species is the same as ours, we have had an opportunity of ascertaining, independently of the description, by the inspection of a drawing of the Swedish mollusk, with which we have been favoured by the author.

With us, this species must be considered very rare, a single specimen only having been got by Mr. David Landsborough on the Ayrshire coast, and two by ourselves in the Isle of Man. The spawn occurs in June, and is deposited in a narrow, undulating, spiral cord of four volutions.

This beautiful *Eolis* comes very near to some of our other British species, but is readily distinguished by the white lines on the body, particularly those on the sides, and by the bifurcating line in front.

Figs. 1, 2, 3. *Eolis lineata*, different views.

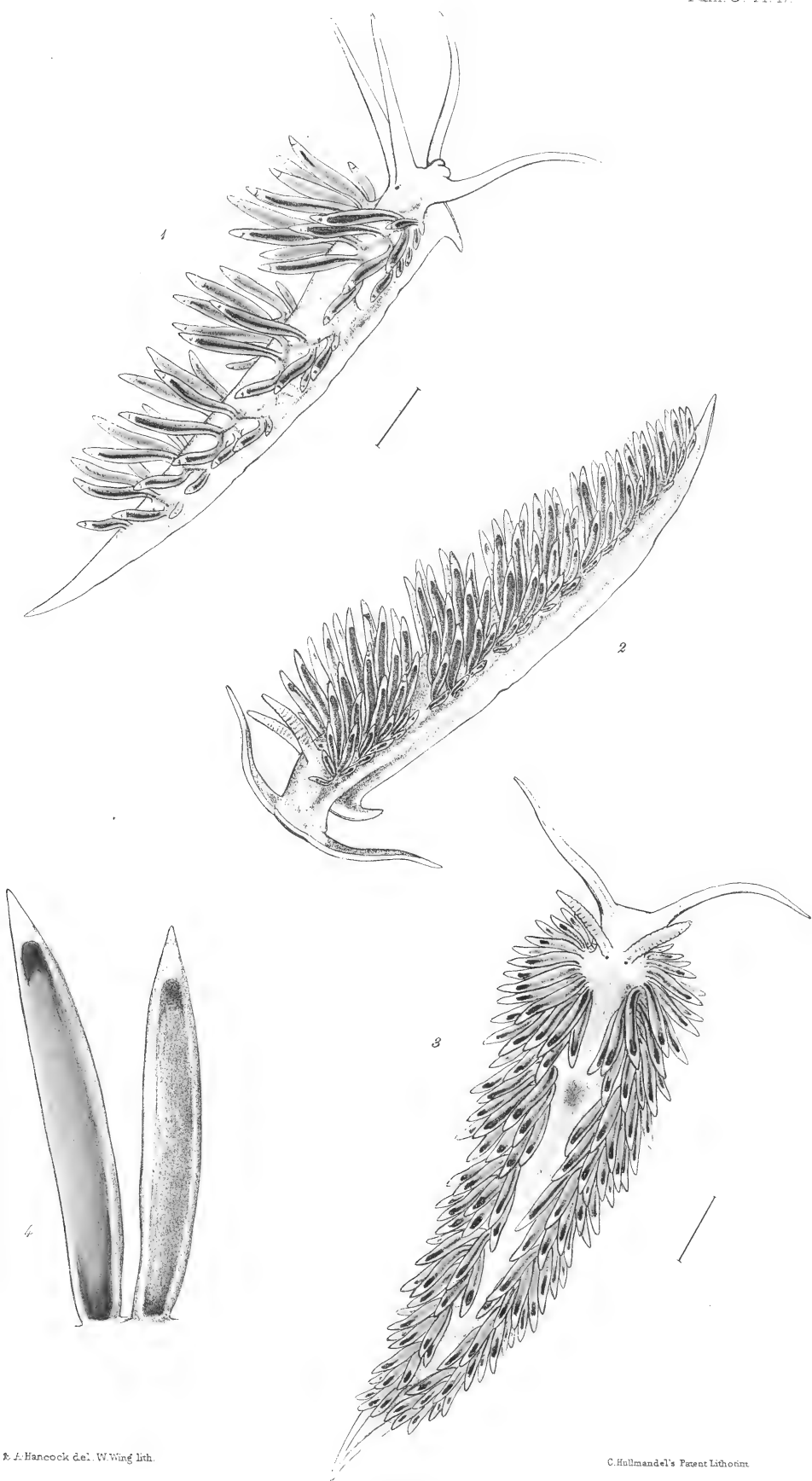
4. Two of the papillæ more highly magnified.

5. The spawn.

6. A portion of the same showing the ova.







J. Alder & A. Hancock del. W. Wing lith.

C. Hullmandel's Patent Lithogr.

Fig. 1. EOLIS SMARAGDINA. Figs. 2, 3, 4. EOLIS ELEGANS



## Fam. 3, Plate 17.

*Figs. 2, 3, 4.*

### EOLIS ELEGANS, ALDER and HANCOCK.

*E. gracilis*, subpellucida, albida, branchiis linearibus roseis, supra et infra nigro-purpureo marginatis, apicibus albis; fasciculis 7, dense degestis; tentaculis dorsalibus breviusculis, corrugatis, luteis; tentaculis labialibus longis; angulis anterioribus pedis productis.

*Eolis elegans*, Ald. and Hanc., in Ann. Nat. Hist., v. 16, p. 316.

*Hab.* Dredged in deepish water, Torbay, J. A.

*Body* about half an inch long, slender, sub-pellucid, yellowish white. *Dorsal tentacles* of moderate length, stoutish, erect, tapering at the top, and wrinkled transversely, of a pale fawn colour or buff, with a streak of white in front near the apex. *Oral tentacles* long, being nearly twice the length of the dorsal pair, tapering, and sloping at the base into the line of the head, which is rather narrow. An opaque white line extends down each, and is continued across the front of the head. *Branchiae* numerous, nearly linear, set in about seven dense clusters down the sides, leaving only a small space between on the back. The first cluster is large, containing about thirty papillæ, which approach very near to the dorsal tentacles, extending a little beyond them at the sides; the remaining clusters diminish gradually in the number of papillæ, the posterior one approaching very near to the tail. The papillæ on the back are longish, those next the foot very small; they are of a bright rosy flesh-colour, terminating above and below in a patch of deep purple-brown approaching to black; the apices are ringed with opaque white. *Foot* transparent, margined with a line of opaque white, and produced laterally in front into longish angles, which are usually curved backwards.

Of this charming *Eolis* only one example has occurred to us, which was dredged in about fifteen fathoms off Berry Head in Torbay. The contrast of the dark spot terminating the rose-coloured branchiæ, with the white ring immediately above it, gives this little creature a very elegant appearance. Unfortunately our captive did not live long. When in a sickly state, it appeared to throw off its papillæ by a voluntary effort. Before casting each, it withdrew the central vessel with its black tip half way down the sheath, leaving the upper part quite transparent and colourless; it was then detached, and moved about in the water, twisting and contracting itself like a worm for a few minutes, after which it became quiescent, and generally burst, discharging the interior in a mass of bright red globules. This motion was evidently muscular, differing in this respect from the usual progress of these organs through the water, when detached, by means of vibrating cilia. Some of the papillæ burst without being detached.

### Fam. 3, Plate 17.

Fig. 1.

#### EOLIS SMARAGDINA, ALDER and HANCOCK.

*E. gracilis*, alba, pellucida; capite curto; branchiis elliptico-oblongis viridibus, apicibus albis, fasciculis 5 digestis; tentaculis dorsalibus et labialibus longiusculis, æqualibus; angulis anterioribus pedis productis.

*Hab.* Among sea-weeds between tide-marks, very rare. Whitley, Northumberland, A. H.

*Body* about half an inch long, slender, pellucid, white, with most of the small branches of the gastric system appearing through the skin of a pale green colour. *Dorsal tentacles* rather long, slender, smooth, and tapering, transparent white, or nearly colourless. *Oral tentacles* of the same length as the dorsal pair, and equally destitute of colour or markings; their external bases form the sides of the head, which is very short. *Branchiæ* rather large, elliptical, or nearly linear; the central vessel of an emerald green colour; the tips pellucid, with a slender ring of opaque white. They are arranged down the back in five well-defined clusters. *Foot* slender, pellucid, produced at the angles into moderately long processes.

We have taken only one individual of this *Eolis*. It occurred at Whitley, in June, 1843, crawling upon the common *Fucus vesiculosus*. This position was most likely accidental; at least it must not be taken as a proof that the species is less carnivorous than its congeners, for we saw it, during its captivity, seize and actually devour a portion of a living *E. gracilis* that was in the same glass with it.

The nearest allies of *E. smaragdina* must be looked for among the *Eolides* with red branchiæ, as no other green species that we are acquainted with belongs to the same section of the genus. It approaches very near to *E. gracilis*, from which it differs chiefly in the colour of the branchiæ and the shortness of the head.





Hancock del.

W. Wing lith. Ford & West Imp.

*EOLIS GRACILIS.*

## Fam. 3, Plate 18.

### EOLIS GRACILIS, ALDER AND HANCOCK.

*E. gracilis*, alba; capite longiusculo; branchiis aurantiacis, apicibus albo-annulatis, in fasciculis 4 digestis; tentaculis longis, brevibus; angulis anterioribus pedis productis.

*Eolis gracilis*, Ald. and Hanc., in Ann. Nat. Hist., v. 13, p. 166.

For. and Hanl., Brit. Moll., v. 3, p. 595.

*Hab.* Under stones, and on corallines, at low-water mark, and a little above, rare. Cullercoats, and Whitley, A. H. Newbiggin, Northumberland; and Menai Straits, J. A.

*Body* rather more than half an inch long, very slender, pellucid white, tinged in the centre with pale greenish yellow, from the viscera appearing through. *Head* rather long and narrow. *Dorsal tentacles* long, slender, linear and smooth, approximating at the base, and much inclined forward; transparent white, with opaque tips, which are carried widely apart. *Oral tentacles* also slender, and a little exceeding the dorsal ones in length, set on a line with the sides of the head, and generally held in a graceful curve. *Branchiæ* slightly elliptical, slender, orange-red, with a delicate opaque white ring near the apex; the central gland, when viewed through a lens, is slightly granular. They are set in four clusters down each side of the back; the first cluster containing twelve or fourteen papillæ, the second ten, and the posterior ones fewer. *Foot* slender, transparent white, grooved in front, where the outline is rather convex, extending into moderately-sized tentacular points at the sides; and terminating in a rather obtuse point behind, considerably beyond the papillæ.

This delicate and graceful *Eolis* has been found occasionally on the Northumberland coast, where it is by no means common, and must be considered among the rarer species of the genus. Beyond that locality a single specimen only has been met with, which was taken by the dredge in a few fathoms' water in the Menai Straits. It spawns in May, on the underside of stones. The spawn forms a spiral cord of four or five volutions, a little waved. The ova are numerous, and closely arranged through the cord, about six or seven in width, but without apparent order.

The specimen from which the original description was taken, had the papillæ of a ginger-orange colour, and was more attenuated in form than any we have since taken; the head, too, was narrower, and the tentacles longer; but notwithstanding these and other minor differences, we are not inclined to elevate these two varieties to the rank of species. It is desirable, however, to see more specimens of the ginger-orange coloured form.

This species moves very gracefully, carrying the dorsal tentacles much forward and perfectly straight, while the oral ones are waved about in elegant curves.

Fig. 1, 2, 3. *Eolis gracilis*, different views.

4. Three of the papillæ.

5. Spawn.

6. A portion of the same showing the arrangement of the eggs.







A.H. del

C. Hullmandel's Patent Lithofint.

EOLIS PELLUCIDA.



## Fam. 3, Plate 19.

### EOLIS PELLUCIDA, ALDER and HANCOCK.

*E. gracilis*, alba, pellucida: branchiis linearibus, roseis, apicibus albis, in fasciculis 5-6 digestis: tentaculis dorsalibus elongatis, levitèr corrugatis: angulis anterioribus pedis valdè productis.

*Eolis pellucida*, Ald. and Hanc. in Ann. Nat. Hist. v. 12, p. 234.

*Hab.* On a Tubularia from the fishing-boats, Cullercoats, A. H.

*Body* seven eighths of an inch long, slender, very pellucid, white. *Dorsal tentacles* long, rather conical, approximating at the base, and of a delicate olivaceous hue with white tips; they are finely annularly wrinkled, the wrinkles discernible even when the tentacles are fully stretched. *Oral tentacles* of equal length with the dorsal pair, and of a watery transparency with white tips. *Branchiæ* long, linear, or slightly conical, bright carmine-coloured, with a large patch of white at the apices. The coloured vessel is rather jagged at the sides but not granular, and forms a cylindrical mass up the centre of the sheaths, which extend a good deal beyond it on each side. The very extreme points are slightly pellucid, but not so as to form the white into a ring as in *E. gracilis*. The branchiæ are arranged in five or six clusters along the sides of the back; the anterior clusters containing from fifteen to seventeen papillæ each, and forming a kind of ruff about the shoulders. The second clusters are also well defined, but not nearly so numerous; the others are smaller, and nearly coalesce towards the tail. *Foot* pellucid, produced at the anterior angles into long slender points, which are generally much recurved. The tail terminated very abruptly in our specimen, but appeared to be injured. The eyes are very small, and placed nearer together than usual.

The specimen of this beautiful animal from which the description was taken was the only one procured, and; though a little mutilated, it lived several days and was very active. It had lost some of its papillæ, but one of the larger clusters appeared quite perfect, and sufficient of the others remained to show their character and arrangement.

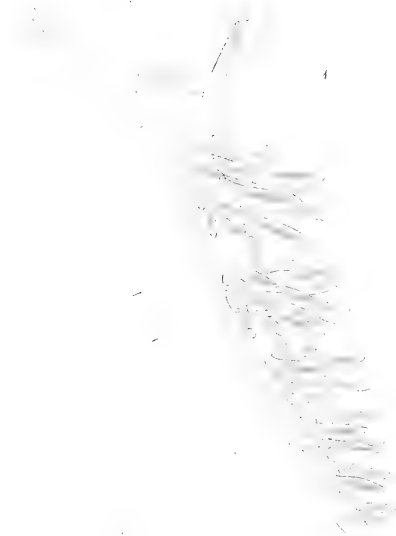
This species is allied to *E. gracilis*, but is much larger; the branchial papillæ are different in form and colour, and the shape of their central vessel is also dissimilar. In this species the dorsal tentacles are olivaceous and wrinkled, in *E. gracilis* they are colourless and smooth. Other minor points of difference might be cited, but those already alluded to are sufficient to warrant our considering the species distinct.

Figs. 1, 2, 3. *Eolis pellucida*, different views.

4. Two of the papillæ more highly magnified.







A. Hancock del. H. Holmes lith.

C. H. Jones del. J. Parry

EOLIS LANSBURGHII.

## Fam. 3, Plate 20.

### EOLIS LANDSBURGII, ALDER and HANCOCK.

*E. gracilis*, violacea: branchiis elliptico-linearibus, aurantiaco-rubris, apicibus albus in fasciculis 5-6 digestis: tentaculis linearibus violaceis, apicibus albis: angulis anterioribus pedis paululum productis.

*Eolis Landsburgii*, Ald. and Hanc., in Ann. Nat. Hist. v. 18, p. 294.

*Hab.* Among rocks at Saltcoats, Ayrshire, rare, *D. Landsborough*, Esq.

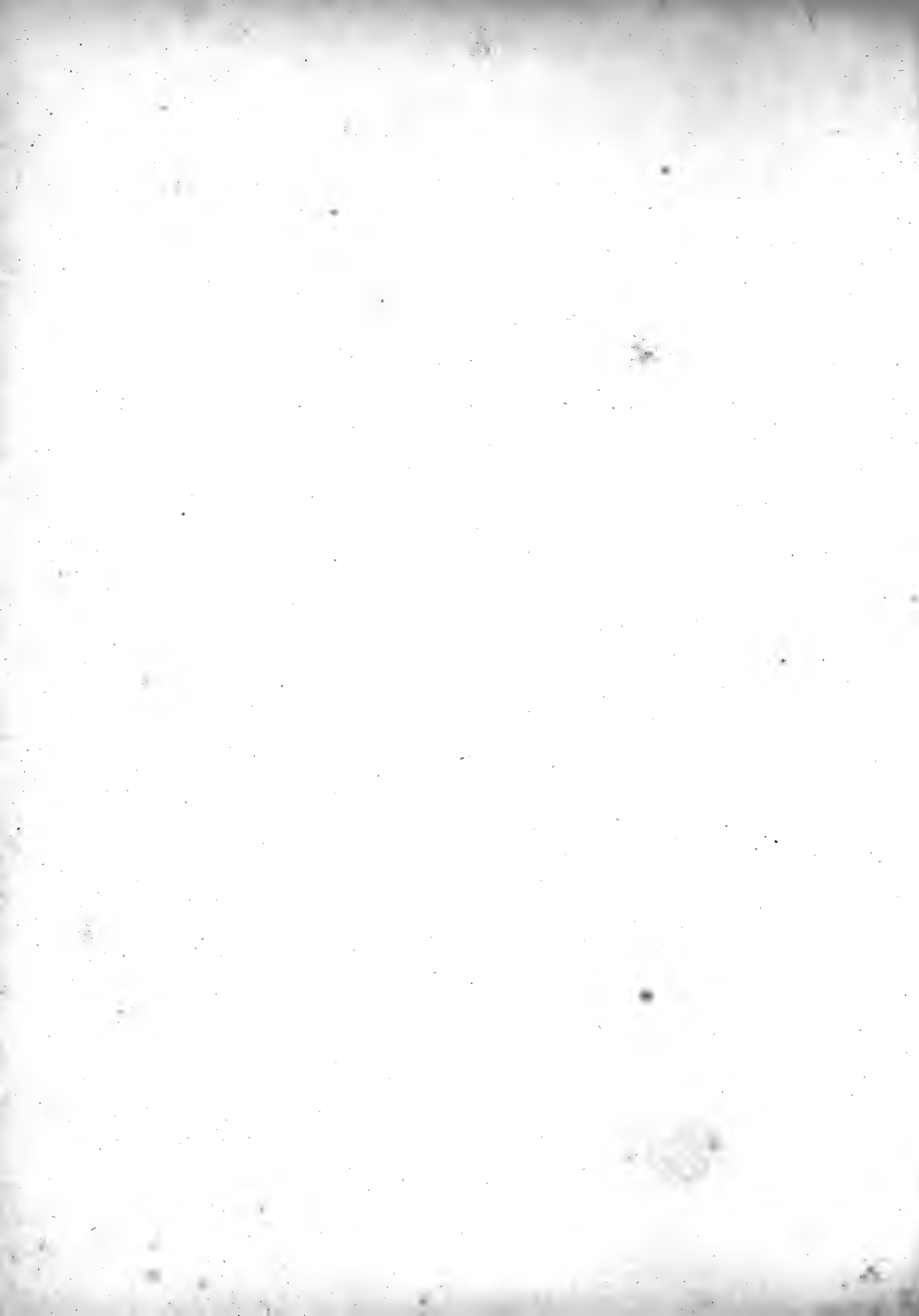
*Body* three tenths of an inch long, very slender, and of a beautiful violet or amethyst colour. *Dorsal tentacles* moderately long, slender, linear, violet tipped with yellowish white. They are set a little apart at the base; the tips widely separated, and not much inclined forwards. The eyes are placed rather far behind them. *Oral tentacles* a little longer than the dorsal pair, and of the same colour: they form a continuous outline with the sides of the head, as in *Eolis coronata*. *Branchiæ* rather short and stout, nearly linear or slightly elliptical; the central gland of an orange red, not granular; the sheaths rather wide, pale, transparent violet, with a ring of white at the apices. They are set down the sides of the back in five or six clusters: the first containing from eight to twelve papillæ; the second from six to nine; and the others fewer, as they approach the tail. *Foot* of a yellowish hue down the centre, with the margins of a pale violet; very narrow, arched in front, with the lateral angles acute, but not much produced; terminating in a fine point behind, a little way beyond the branchiæ. *Mouth* very small and nearly circular.

Of this charming little *Eolis* only one specimen has yet been found, which was discovered at Saltcoats, in June 1846, by Mr. David Landsborough, Junr., who obligingly transmitted it to us alive. The beautiful and delicate amethystine colour of the body distinguishes it from all the other British *Eolides*. We have named it after its discoverer.

*Eolis Landsburgii* is rather an active animal, but it makes very little progress when floating at the surface of the water, probably on account of the narrowness of the foot. When the specimen came into our possession, several of the papillæ had fallen off, but in the course of a few days new ones made their appearance, and, in two or three days more, had attained considerable size.

Figs. 1, 2, 3. *Eolis Landsburgii*, different views.

4. Two of the papillæ more highly magnified.







A H del

C. H. Marshall & G. W. Brown

EOLIS ALBA



## Fam. 3, Plate 21.

### EOLIS ALBA, ALDER and HANCOCK.

*E. gracilis*, alba ; branchiis oblongis, sub-linearibus, albis, apicibus interdum fusco-cinctis, in fasciculis 5-6 digestis ; tentaculis dorsalibus fuscis, superne in bulbo expansis ; angulis anterioribus pedis valdè dilatis.

*Eolis alba*, Ald. and Hanc. in Ann. Nat. Hist. v. 13, p. 164.

*Hab.* On sponge from shallow water, Malahide, near Dublin. Under stones at low-water mark, Rothesay Bay.

*Body* half an inch long, very slender, and tapering to a fine point behind ; pellucid white with a yellowish tinge from the viscera shining through. A broad patch of opake white runs along the head to the dorsal tentacles, passes in a narrow band between them, and is divided behind into two branches extending to the first branchial papillæ, where they again unite, forming a triangle or lozenge-shaped patch, which is continued backwards, and assumes an elliptical form over the heart ; it then contracts and passes in a single interrupted line down the back to the tail. *Dorsal tentacles* rather long, smooth, approximating at the base, tapering slightly for about three fourths of their height, when they swell into a bulb or button-like expansion, above which they become more slender and taper to an abrupt point. They are of a dark olive brown approaching to black below the bulb, and white above it. *Oral tentacles* long, nearly linear, swelling a little at the base, and tapering at the point, which is opake white, the rest transparent. They arise from the sides of the head, the form of which they determine. They are usually held in a gracefully curved position. *Head* rather narrow. *Branchiæ* arranged in five or six clusters on each side of the back, four of which are very distinct and well defined, the opposite ones approaching each other in the centre more nearly than usual, and having a ruff-like appearance. The first and second clumps which are at a considerable distance from each other, are composed of two transverse rows each, six or seven papillæ in each row ; the others are in single series, and decrease towards the tail. The papillæ are of moderate length, linear oblong, and slightly flattened at the base, where they are pellucid and tinged with yellow from the central vessel appearing through ; the rest is of an opaque white, excepting, in some specimens, a dark olive coloured circle near their termination, above which is another band of opake white ; the apices are pellucid. *Foot* narrow, nearly linear, and perfectly transparent, terminating behind in a very fine point, extending considerably beyond the branchiæ. The anterior angles are produced into long, slender, tentacular processes, curved backwards. A deep groove extends across the front of the foot to their points ; the central portion is curved inwards, giving the whole of this part a bow-like outline. The eyes are conspicuous and placed as usual behind the dorsal tentacles.

## EOLIS ALBA.

The elegant and graceful form of this little animal renders it extremely attractive. The dorsal tentacles are peculiar.

It was first found in Malahide Bay, where we dredged up two specimens in about four fathoms water, in August, 1843. They were adhering to the common sponge, (*Halichondria panicea*,) which is very abundant in this locality, and grows to a larger size than we have elsewhere seen. It probably constitutes the chief food of this and numerous other nudibranchs that were found upon it. That this species, however, is not very scrupulous in adhering to such diet we have reason to know. The two individuals after travelling three hundred miles by post, lived with us two or three weeks. They were very active, and glided rather quickly through the water. The dorsal tentacles were generally inclined forwards and spread much apart, the oral ones were arched gracefully backwards, and kept in constant motion. The papillæ usually lay rather close to the body, but frequently they were spread out and curved in a very graceful manner. Finding that they had devoured the spawn of another *Eolis* kept in the same glass with them, they were afterwards fed with the spawn of a *Polycera*, which they always laid hold of with great avidity; another proof, if any were wanting, of the carnivorous habits of this genus. They were always most active at nights. Their spawn was deposited in a slender gelatinous flattened thread forming a delicate spiral coil of seven or eight volutions; the eggs are oval, and lie three or four abreast through the whole length of the thread.

- Fig. 1, 2, 3. *Eolis alba*, in different positions.  
4. Two of the papillæ more highly magnified.  
5. Spawn.  
6. A portion of the same, showing the ova.

(The figures in this Plate have inadvertently been reversed.)

# EOLIS.

the spermatheca; *i*, duct of the same; *j*, small accessory gland of the same; *k*, anterior genital artery. (The letters of this figure correspond to, and will explain those of Plate 4, fig. 15.)

- Fig. 3. Cerebral ganglions and nerves:—*a*, *a*, central or upper ganglions; *b*, *b*, lateral ganglions; *c*, under or buccal ganglions; *d*, *d*, gastric ganglions; *e*, inner œsophageal collar; *f*, outer ditto; *g*, central ditto; *h*, *h*, genital and cardiac nerves; *i*, *i*, hepatic ganglions imbedded in the muscles of the buccal mass; *j*, *j*, hepatic nerves, supplying the glands of the papillæ; *k*, short cord uniting the same to the outer collar; *l*, eye; *m*, auditory capsule; 1st pair of nerves supply the dorsal tentacles; *á á*, ganglions at the base of the same; 2d pair go to the outer lip; 3d pair to the skin in front of the head; 4th pair supply the channel of the mouth and oral tentacles; 5th pair go to the channel of the mouth near the buccal mass; 6th, 7th, 8th, and 9 pairs, supply the skin on the sides of the body; 10th pair supply the foot; 11th pair supply the skin on the sides of the back; 12th pair supply the skin of the back next the median line.
4. Auditory capsule, inclosing the inner capsule and otolithes.
  5. Otolithes very highly magnified:—*a*, one fractured by pressure.
  6. Auditory capsule with otolithe of *E. picta*.
  7. Eye of *E. picta*:—*a*, optic nerve; *b*, pigment cup; *c*, lens; *d*, cornea; *e*, general capsule.
  8. Digestive apparatus of *E. despecta*; letters as in Pl. 7, fig. 2.
  9. A branchial papilla of *E. papillosa*, exhibiting the hepatic gland, &c.:—*a*, ovate vesicle; *b*, gland; *c*, duct; *d*, wall of inner sheath.
  10. A papilla of *E. Farrani*, exhibiting the gland; lettered as the last.
  11. A much enlarged representation of the upper portion of a papilla of *E. papillosa*:—*a*, hepatic gland; *b*, vessel leading from the gland to the ovate vesicle, *c*; *d*, orifice at the apex of the papilla communicating with the ovate vesicle; *e*, muscles attaching the vesicle to the walls of the papilla; *f*, *f*, inner sheath inclosing the gland; *g*, *g*, muscular bands inclosing the cellular spaces, in which the blood circulates between the inner sheath (*f*, *f*) and the skin of the papilla; *h*, skin of the papilla clothed with vibratile cilia; *i*, *i*, *i*, circular and longitudinal muscular fibres of the skin.
  12. Utricle, or bag, from the ovate vesicle of *E. papillosa*, containing the supposed stinging bodies.
  13. Utricle from the ovate vesicle of *E. coronata*, containing the stinging and other bodies.
  14. Stinging bodies of *E. papillosa*, with the hair-like filaments as they appear after ejection:—*a*, one of these bodies, showing two dark lines in the centre.
  15. Stinging bodies from the ovate vesicle of *E. olivacea*.
  16. One of the flattened elliptical bodies, contained along with the stinging bodies in the utricle of *E. coronata*.
  - 17, 18. External and internal views of a horny plate of the jaws of *E. papillosa*:—*a*, cutting blade; *b*, fulcrum, or hinge.
  19. Front view of the horny jaws:—*a*, cutting blades; *b*, hinge or fulcrum.







J. Alder del. V. Wang lit.

Ford & West. Imp.

*EOLIS GLAUCOIDES.*

## Fam. 3, Plate 22.

*Figs. 1 to 4.*

### EOLIS GLAUROIDES, ALDER AND HANCOCK.

*E. alba*, depressa, capite parvo; tentaculis parvis, simplicibus; branchiis linearibus, albis, apicibus fulvis, glandulâ centrali subfulvâ, in fasciculis pedunculatis 11 utrinque digestis; pede lato, angulis anterioribus acutis.

*Hab.* Under stones at low water mark, Herm Island, near Guernsey, *J. A.*

*Body* about half an inch long, depressed, rather broad, transparent white, with opaque white spots. *Head* small and narrow. *Dorsal tentacles* short, linear, simple, white with opaque tips. *Oral tentacles* very short, and broadish at the base. *Branchiæ* nearly linear, tapering towards the top, transparent white, covered with minute opaque white spots; the central gland is narrow, linear, and of a pale fawn colour; the apices yellowish, deepening into fawn colour towards the tips. They are set in eleven clusters, of three or four papillæ each, down the sides of the back, each cluster arising from a short foot-stalk; they commence near the tentacles, and reach nearly to the tail, the posterior papillæ extending a little beyond it. A few of the papillæ nearest the back have a slight angle towards the base. *Foot* broad, and rather thin at the edges, arched in front, and extending into acute angles at the sides; terminating behind in an obtuse rounded tail. It is transparent white, with a darkish line down the centre from the gastro-hepatic vessel appearing through. A less distinct, interrupted darkish line is visible down the centre of the back.

This very curious *Eolis* shows, in most of its characters, an approach to the genus *Glaucus*, particularly in the small size of the head and tentacles, and in the branchial papillæ being arranged in clusters, arising from a short foot-stalk. Its anatomical characters bear out this resemblance. A remarkably large and wide gastro-hepatic vessel occupies the centre of the body, giving off branches on each side to the branchial pedicles. The ovary, which, from the transparency of the skin, is visible outside, is divided into two lateral portions, which pass down the body, and are united posteriorly above the gastro-hepatic vessel. The jaws are small and truncated behind; and the tongue is very minute, long, and slender, composed of a single series of plates, each bearing a single spine.

When the genus *Eolis*, as we at present retain it, comes to be broken up, this species will probably constitute a new generic type.

Figs. 1, 2, 3. *Eolis Glaucoides*, different views.

4. Branchial papillæ more highly magnified.





## Fam. 3, Plate 22.

*Fig. 5.*

### EOLIS STIPATA, ALDER AND HANCOCK.

*E. ovato-oblonga*, sub-depressa, antica obtusa; lutescenti-viridis; branchiis sub-clavatis viridibus, in seriebus 9 digestis; tentaculis brevibus; angulis anterioribus pedis brevibus.

*Eolis stipata*, Ald. and Hanc., in Ann. Nat. Hist., v. 12, p. 233.

For. and Hanl., Brit. Moll., v. 3, p. 597.

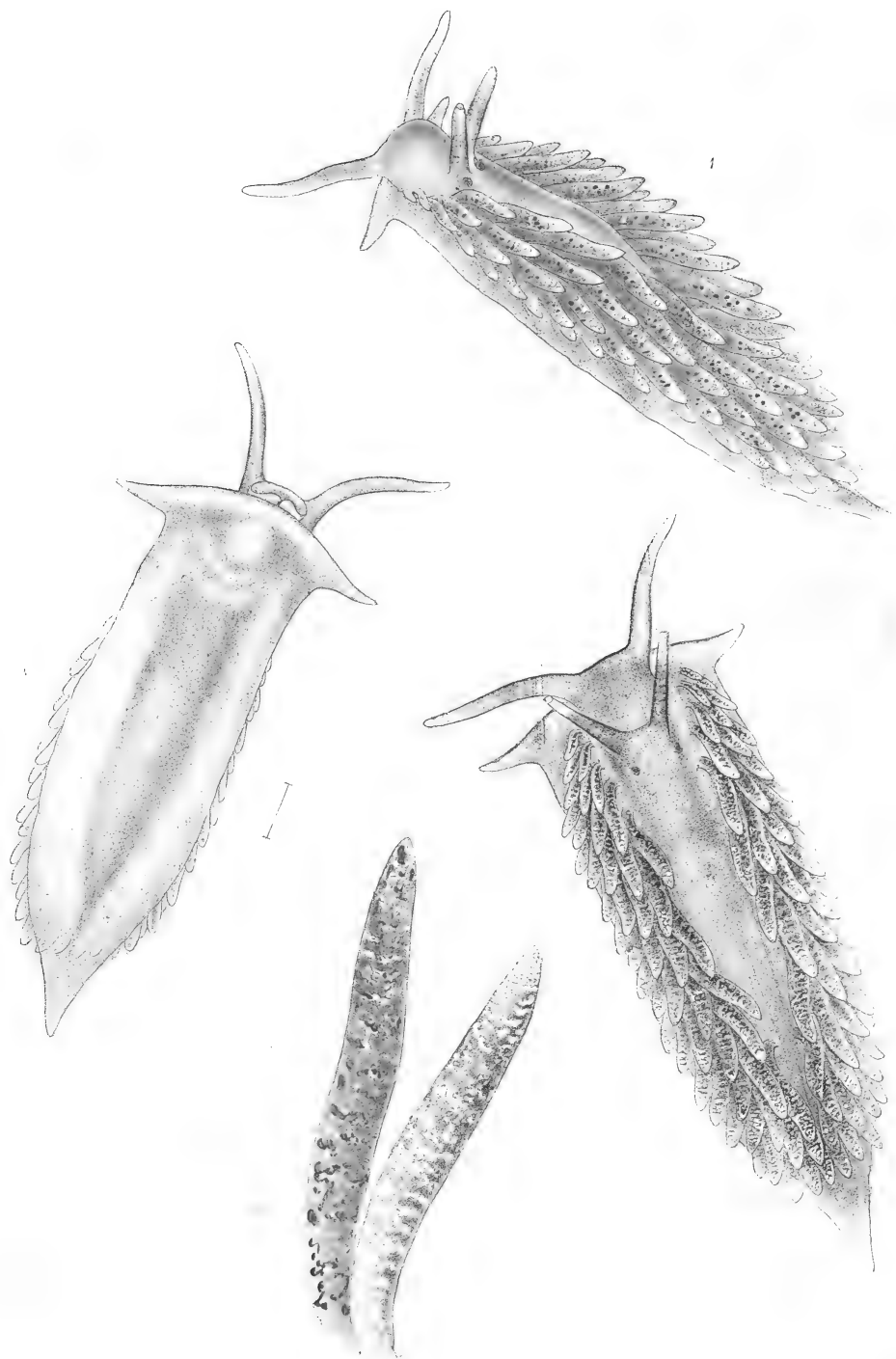
*Hab.* On a Sertularia, dredged in Torbay, *J. A.*

*Body* a quarter of an inch long, rather depressed, broad in front and ending in an obtuse point behind, of a bright yellowish-green, paler towards the head. *Dorsal tentacles* rather short, subconical, smooth, of a greenish white, held nearly erect. *Oral tentacles* short and thickish, set wide apart on the head, which is broad and rounded in front. *Branchiae* numerous, rather short, ovate-oblong or sub-clavate, stout, bright bluish-green, paler and yellowish towards the apex, arranged in nine or ten close transverse rows of eight papillæ each, nearly covering the back, and coming close to the dorsal tentacles in front: each row is set on a transverse ridge. *Foot* transparent white, rather broad, with the anterior angles not much produced.

An individual of this interesting species was obtained by the dredge at Torquay, in September, 1842. It lived only a very short time after its capture, so that a single sketch only could be taken of it.







Widmann Patent Litho.

Fam. 3, Plate 23.

EOLIS ANGULATA, ALDER and HANCOCK.

*E. subangulata*, depressa, pallide aurantiaca: branchiis cylindricis, aurantiacis, albo maculatis; tentaculis brevibus; angulis pedis acutis.

*Eolis angulata*, Ald. and Hanc. in Ann. Nat. Hist. v. 13, p. 165.

*Hab.* On a stone from the fishing boats, Cullercoats.

*Body* about four lines long, depressed, subangulated, broad in front, and terminating rather abruptly behind, of a pale pellucid orange colour. *Dorsal tentacles* short, conical, obtuse, orange tipped with white; set a little apart and only slightly inclined forwards. *Oral tentacles* rather longer than the dorsal ones, nearly linear, rather obtuse, the lower portion transparent, the rest of an opake white. The eyes are very large, and placed a little behind the dorsal tentacles. *Branchiæ* cylindrical, rather long, slightly elliptical, obtusely pointed, orange-coloured with white apices; the surface covered with opake white blotches. The central vessel is slightly granular and nearly fills the sheath, except at the top, the points extending considerably beyond it. They are arranged along the sides in ten or twelve close-set, but well-defined, rows of four or five papillæ each, leaving a broad space on the back. *Foot* broad, transparent, and delicately tinged with orange. It extends only a short way beyond the branchiæ behind, where it suddenly tapers to a fine point: it is broad in front and produced into lengthened angles at the sides.

A single specimen of this species was obtained from a stone brought in by the fishermen at Cullercoats, probably from deepish water. It lived several days, and moved about with much ease and rapidity, swimming at the surface of the water much more quickly than usual.

Fig. 1, 2, 3. *Eolis angulata*, different views.  
4. Two of the papillæ more highly magnified.






$$L = \int dt \int d\tau$$

C. Hulbush and S. Patent Latholm

# THE CONCINNA



## Fam. 3, Plate 24.

### EOLIS CONCINNA, ALDER and HANCOCK.

*E. albida*; branchiis purpureo-fuscis, sub-nitentibus, in seriebus 9-10 digestis; tentaculis lævibus: angulis anterioribus pedis paululum extensis.

*Eolis concinna*, Ald. and Hanc., in Ann. Nat. Hist. v. 12, p. 234,

*Hab.* Under stones, between tide marks. Whitley, Northumberland.

*Body* nearly half an inch long, sub-linear, pellucid white, tinged with buff or yellow. *Dorsal tentacles* rather longish, linear, tapering, transparent, with opaque white tips; set near together at the base, spreading apart above, and generally inclined forwards. There is a dark cruciform mark on the head in front of them, produced by the jaws appearing through. *Oral tentacles* about one third shorter than the dorsal ones, linear, arising from the upper surface of the lips. *Branchi* oblong, sub-conical, purplish brown in the centre, and granulated; the external envelope transparent and tinged with blue, giving the whole a metallic hue; the apices strongly tipped with white. They are placed in 9 or 10 transverse rows of 5 papillæ each in the sides, leaving a wide space down the centre of the back. The rows are set a little apart, and diminish posteriorly. *Foot* nearly linear, pellucid, stained with buff, extending considerably beyond the branchiæ behind; the front transversely grooved, and produced at the sides into obtuse points. The eyes are immediately behind the dorsal tentacles, and are well developed.

Though less brilliantly coloured than many others of the genus, the silvery hue of the papillæ, when in motion, gives the species a very pretty appearance.

Four specimens were obtained in a pool at low-water mark, on the under side of a stone, crawling on *Sertularia argentea*. Some of the coralline was removed along with them, and placed in the same glass. On this one or two individuals deposited their spawn. The ova were contained in a broadish transparent strap or belt, which was deposited without apparent order. The departure from the usual spiral form in this instance may have been accidental, arising from the deficient support afforded by the coralline in its detached state.

- Fig. 1, 2, 3. *Eolis concinna*, different views.  
4. Papillæ, more highly magnified.  
5. Spawn.







A Hancock del H. Holmes lithofint.

C Hullmandel's Patent

EQUISETUM NANA.

### Fam. 3, Plate 25.

#### EOLIS NANA, ALDER and HANCOCK.

*E. ovato-oblonga*, luteo-alba; branchiis subclavatis, roseis, apicibus albis; in seriebus 8-10 approximatis digestis: tentaculis dorsalibus lævibus: lateribus capitis dilatatis, rotundatis: angulis anterioribus pedis obtusis.

*Eolis nana*, Ald. and Hanc., in Ann. Nat. Hist. v. 9, p. 36.

*Hab.* Under stones between tide-marks. Whitley and Cullercoats, not common.

*Body* about four lines long, ovate oblong, flattish, tapering to an obtuse point behind; of a pale buff colour on the back, the head and tentacles transparent white. *Dorsal tentacles* moderately long, linear, smooth, tapering towards the extremities, and approximating below: they are carried nearly erect. *Oral tentacles* a little shorter than the dorsal pair, nearly linear, pointed. *Head* broad, rounded, and projecting at the sides considerably beyond the insertion of the oral tentacles. *Branchiæ* subclavate; the central vessel rose-coloured, and conspicuously sprinkled with dark granules; the sheaths wide, with the opaque part near the apex of a faint white, and extending rather further down than in most of the other species. The papillæ are disposed in eight to ten close transverse rows of five or six each along the sides, leaving a bare space on the back, reaching nearly to the tail. A few papillæ extend along the sides of the head in advance of the dorsal tentacles. *Foot* transparent white, rather short, and obtuse behind; the front rounded, and scarcely angulated at the sides.

This species is readily distinguished from most of those with red branchiæ by having the papillæ in close continuous rows, and not arranged in tufts. It holds an intermediate station between the divisions of the genus, agreeing with the first section in its broad and flattened form, as well as in the general arrangement of the papillæ; its colour and the armature of the tongue ally it to the second section; while the auditory capsule, containing only a single otolith, and the character of the spawn, seem to indicate its place in the third section of the genus.

An individual kept in a glass of sea-water showed great restlessness, frequently moving with considerable speed in all directions. Its sensitiveness was equal to its activity; the least agitation of the water causing it to contract its body backwards, and to draw its head and tail together until the whole foot was detached from its hold, and it fell to the bottom of the glass. This restlessness, common to a portion of the genus, renders the task of delineating them rather a difficult one.

We have not yet met with this species beyond the Northumberland coast, and there it is by no means common, and rather uncertain in its appearance. It is found further above low-water mark than any other of the genus with which we are acquainted, and most frequently

#### EOLIS NANA.

occurs under stones left dry by the receding tide. Like the Dorides that inhabit similar situations, it is very liable to crawl up the side of the vessel in which it is kept, and there perish for want of moisture. In consequence of this propensity to crawl out of the water, the true littoral species are all difficult to keep alive; the deep-water species, on the contrary, rarely venture above the surface of the fluid.

*Eolis nana* spawns in May, June, and July, or occasionally as late as August. The spawn resembles that of *E. olivacea*, and is found on the under surface of stones.

Figs. 1, 2, 3. *Eolis nana*, different views.

4. Two of the papillæ, more highly magnified.



Pat. 9, 21, 92



A. H. Gel.

C. Hulman & Co. Patent Engrs. &c.

EOLIS OLIVACEA.



### Fam. 3, Plate 26.

#### EOLIS OLIVACEA, ALDER and HANCOCK.

*E. flavido-alba*, maculis albis; branchiis paucis, crassiusculis, cylindraceis, olivaceis, seriebus 6-8 digestis; tentaculis lævibus; angulis anterioribus pedis brevibus, obtusis.

*Eolis olivacea*, Ald. and Hanc. in Ann. Nat. Hist. v. 9, p. 35.

*Hab.* Under stones between tide-marks, Whitley and Cullercoats, Northumberland, not uncommon. Whitburn, Durham. Rothesay Bay, Isle of Bute.

*Body* about half an inch long, pale yellow or yellowish white, sprinkled with minute spots of opake white. *Dorsal tentacles* rather short, nearly linear, obtuse, approximating at the base, yellow speckled with white, and having a more or less distinct orange-red band in the centre. *Oral tentacles* not so long as the dorsal ones, linear and obtuse, arising from the upper surface of the lips. A streak of orange or rose-red extends on each side of the head between the oral and dorsal tentacles, curving inwards, and is continued behind the latter a short way down the back; in some brilliantly coloured varieties there is a large sub-triangular blotch of rose-red behind these on the centre of the back, and one on each side below the dorsal tentacles. *Branchiæ* rather few, thickish, elliptic-oblong, nearly cylindrical, of a yellowish olive-brown, with numerous belts composed of granulated spots of dark olive, sometimes indistinct. The apices pale; the whole of the external surface covered with patches composed of opaque whitish spots. The branchiæ are set along the sides in 6 to 8 rows of 3 or 4 papillæ each: their size is nearly equal throughout. *Foot* watery white, tapering to a fine point behind; the anterior extremity widened and rounded. Eyes small, placed close behind the dorsal tentacles.

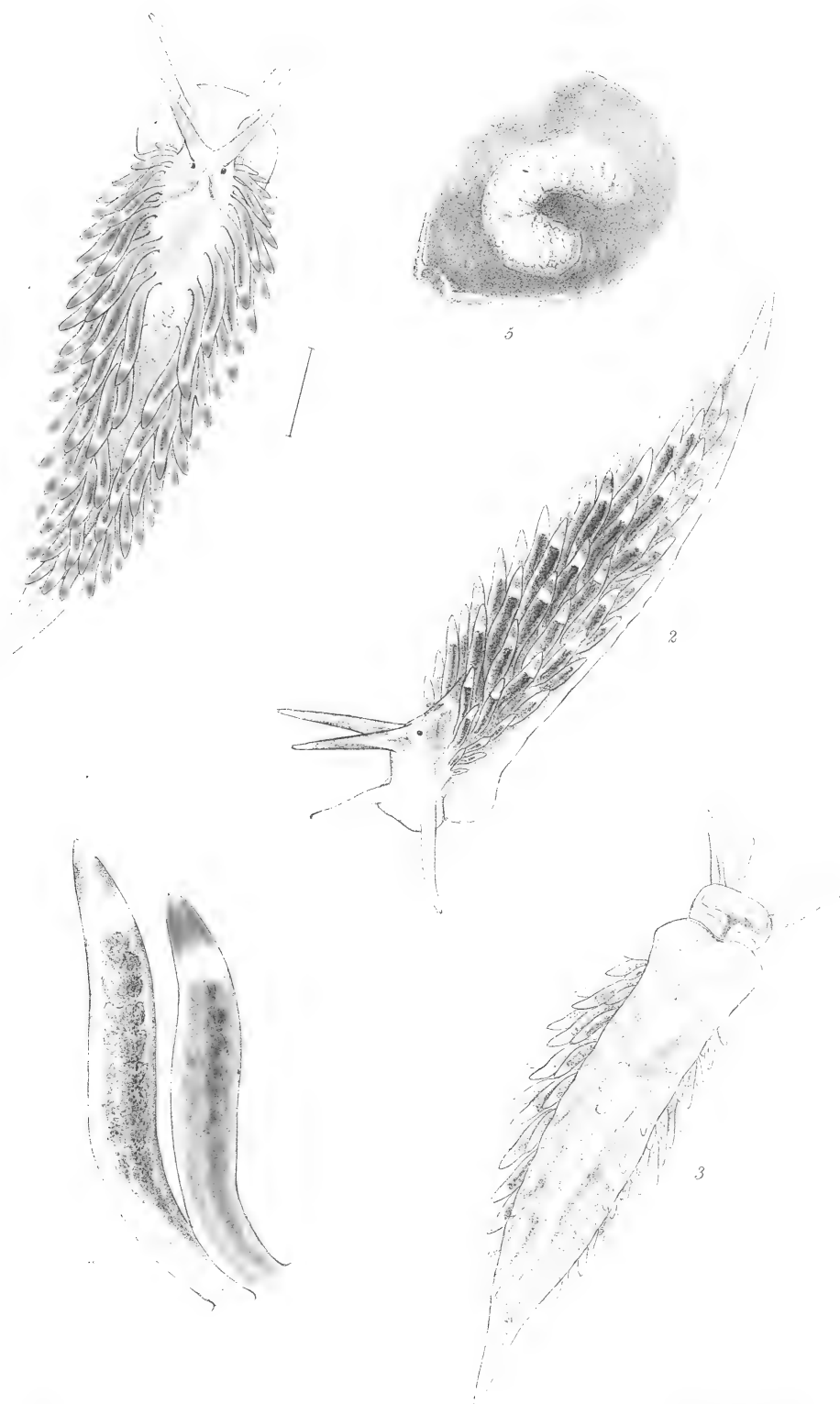
We know of no species with which this can be readily confounded. It is subject to some slight variation in colour. Sometimes a specimen is found with the branchiæ of a richer hue, approaching to reddish brown, and sometimes of a much darker or lighter tint, but the modest olive generally prevails. In a specimen found in Rothesay Bay, the papillæ showed indications of a brown ring at the apex. The spawn, which is deposited in the months of May and June, forms a broad semicircular coil, attached to the under sides of stones. In the simple form of the spawn and the single otolite of the auditory capsule, this species indicates the peculiarities of the section of *Eolis* to which it belongs.

- Fig. 1, 4, 5. *Eolis olivacea* of the usual colour.  
2. The same, rich brown variety.  
3. The same, dark, full-coloured variety.  
6, & 7. Papillæ, more highly magnified.  
8. Spawn.

(The figures in this Plate have inadvertently been reversed.)







A-Haus: von der W-Wing lebt

C-Hullmandel's Patent Lithograph

FOLIS AURANTIATA.

## Fam. 3, Plate 27.

### EOLIS AURANTIACA, ALDER and HANCOCK.

*E. luteola*, subrobusta; branchiis robustis, tricoloribus,—infra purpureo-fulvis, medio albidis, supra aurantiacis,—seriebus densis 10—11 digestis; tentaculis dorsalibus aurantiacis, corrugatis, tentaculis labialibus breviusculis; angulis anterioribus pedis obtusis.

*Eolis aurantiaca*, Ald. and Hanc., in Ann. Nat. Hist., v. 9, p. 34.

*bellula*, Lovén, Index Moll. Scand., p. 8.?

*Hab.* Under stones near low-water mark, and in shallow water, Whitley and Cullercoats, Northumberland, rather rare, *A. H.* Ardrossan, Ayrshire, rare; Fowey Harbour, Cornwall, frequent, *J. A.*

*Body* about half an inch long, rather stout, tapering to a fine point behind, of a delicate buff colour. *Dorsal tentacles* moderately long, tapering, a little wrinkled, of an orange flesh-colour, a little paler above and below; generally inclining forwards, their bases approximating. *Oral tentacles* rather shorter than the superior pair, nearly colourless, linear, and slightly flattened, with blunt points: they are set a little above the margin of the head, which is produced laterally beyond their insertion. *Branchiæ* numerous, placed along the sides of the back in ten or eleven close, but well defined, transverse rows; the anterior rows containing five or six papillæ each, the posterior, two to four. They are linear-oblong, and stout in proportion to the length; the upper portion is bright orange coloured, beneath which is a belt of white, the remainder, varying from two thirds to three fourths of the entire length, is of a warm purplish red, inclining to orange; the colouring of the upper portion is exterior, that of the lower proceeds from the central vessel, the margins of which are undulating, and the surface indistinctly granular. *Foot* transparent white, produced, and slightly lobed in front, tapering to a fine point behind.

The colours of this species vary considerably, as well as the proportions in which they are distributed on the branchiæ; sometimes the prevailing colour is much paler than here described, but in south-country specimens it is generally brighter, the colour of the branchiæ frequently approaching to scarlet. On one occasion we obtained an individual with the central vessel of the papillæ of a warm yellowish olive. The tricoloured character of these organs is prevalent throughout all the varieties; once or twice only have we found the terminal orange portion indistinct or wanting.

*Eolis aurantiaca*, though by no means common, has been found in three widely distant localities in this country, so that its range is pretty extensive; and if, as we think, the *Eolis bellula* of Lovén is a variety of this species, its distribution will be still further extended in the European seas, M. Lovén's specimens having been obtained on the coast of Norway.

On the Northumberland Coast this species is usually found on *Tubulariæ*. The spawn occurs in June and July; it forms a broadish, circular, depressed belt; in which the eggs are divided into transverse masses, somewhat triangular in form.

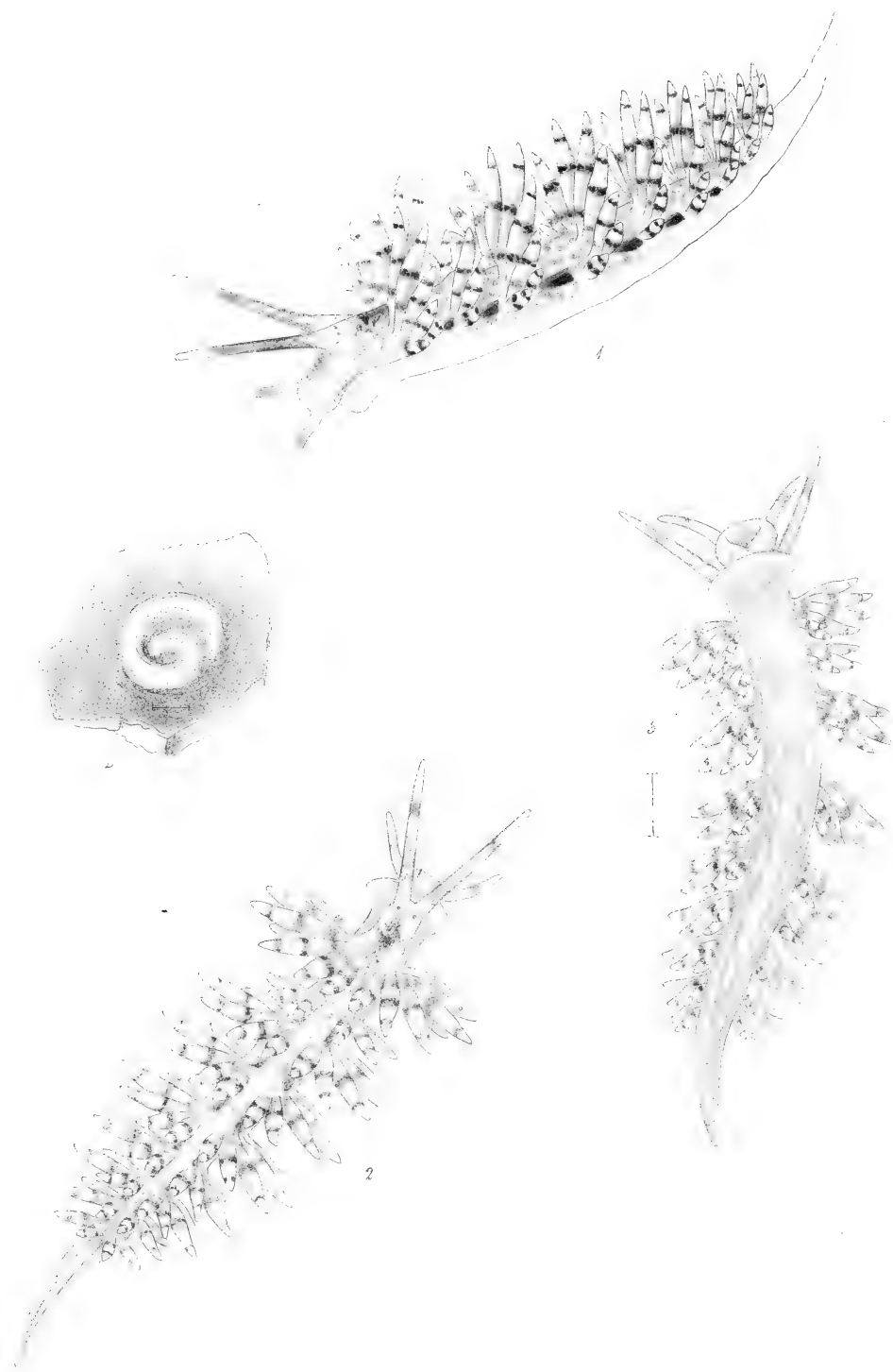
Figs. 1, 2, 3. *Eolis aurantiaca*, different views.

4. Two of the papillæ more highly magnified.

5. Spawn.







A. H. del.

C. Hullmandel's Patent Lithogr.

EOLIS CINGULATA.



## Fam. 3, Plate 28.

### EOLIS CINGULATA, ALDER and HANCOCK.

*E. alba*, olivaceo-maculata: branchiis elliptico-oblongis, albis, annulis 3 olivaceis; in seriebus subremotis 8-9 digestis: tentaculis fulvo-cinctis: lateribus pedis anterioribus paululum productis, rotundatis.

*Eolis Hystrix*, Ald. and Hanc. in Ann. Nat. Hist. v, 9, p. 35.

*Hab.* Among rocks at low-water mark, Cullercoats, rare, *J. A.*

*Body* three eighths of an inch long, slender, tapering to a fine point behind; white, variegated with rich olive-brown spots and blotches; an interrupted line of which runs along each side of the back at the base of the papillæ. *Dorsal tentacles* much inclined forwards, long, linear, smooth, tapering a little towards the top; white, with a central band of orange-brown, and of a pale olive-brown colour towards the base, where they approach each other; between and behind them an irregular patch of olive-brown extends a short way down the back. Eyes distinct. *Oral tentacles* about half the length of the dorsal ones, linear, white, with a belt of orange-brown. *Branchiæ* large, elliptical, oblong when extended, ovate when contracted, swelled in the middle, and tapering to a point. The central vessel is of a pale obscure yellow, nearly filling the sheaths, which are not very distinct; they are encircled by three olive-brown belts, varying in intensity in different parts of the circle, as well as in different individuals, some having the belts very pale, while in others they are of a very dark brown or olive-green. The papillæ are set in eight or nine distant transverse rows of three to five each, diverging at the summits. *Foot* transparent white, very slender and linear, arched in front, with the anterior angles slightly produced and rounded; posteriorly it terminates in a fine point considerably beyond the branchiæ.

A few specimens of this lovely little mollusk were taken in September 1841 under stones among the rocks at the north side of Cullercoats Haven. At that time they were spawning, and two of them deposited their spawn in the glass where they were kept. It consisted of a short, thick, spiral coil, of one and a half or two volutions. Though we have frequently since examined these rocks at the same season of the year, we have not been fortunate enough to meet with the species again.

The branchiæ of *Eolis cingulata* are capable of great contraction, and in that state almost resemble those of a *Doto*. When expanded, however, they

“ stand on end

Like quills upon the fretful porcupine,”

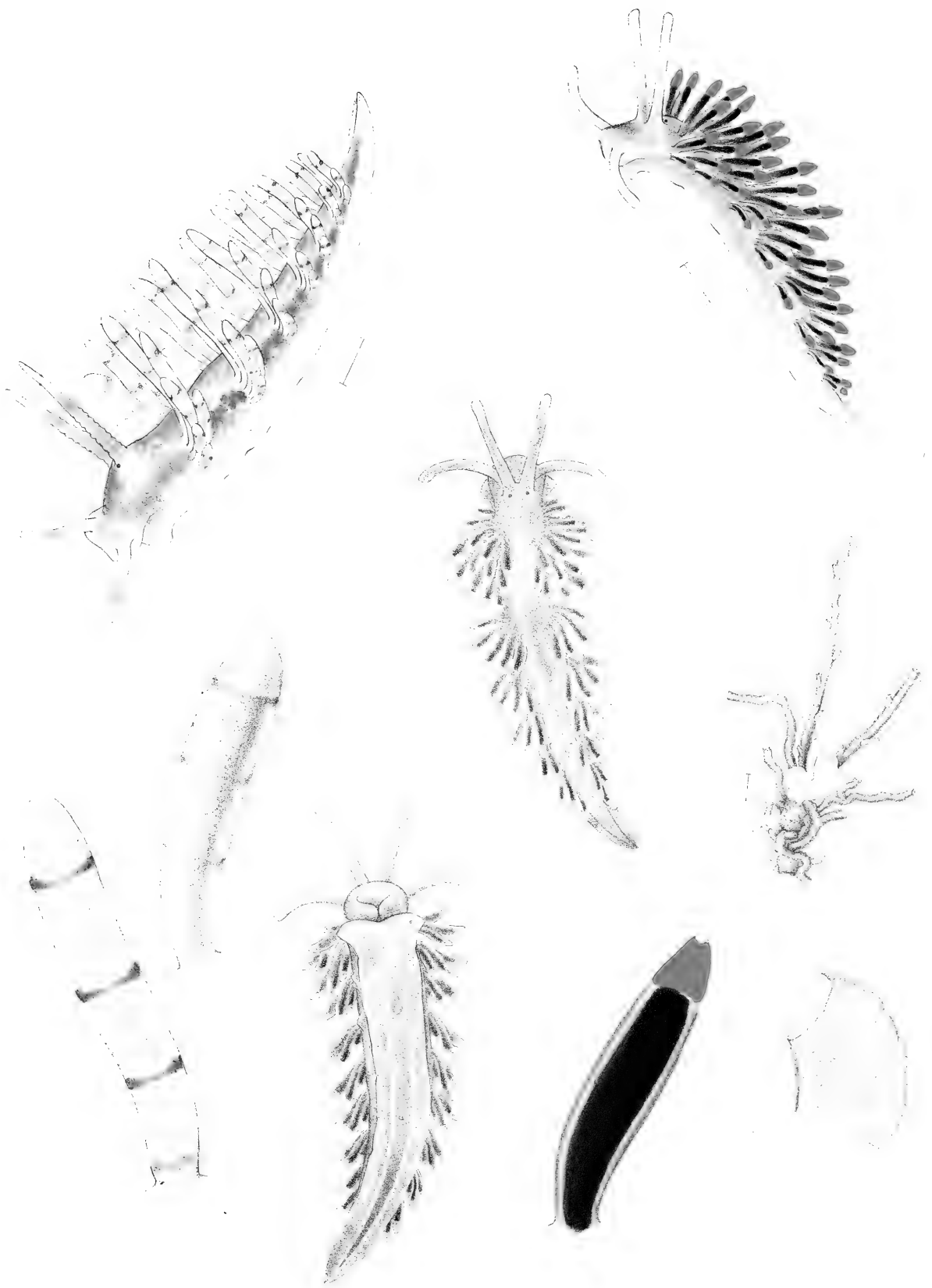
diverging in rays across the back, and giving the little creature a very graceful appearance. This habit, together with the dark bands across the papillæ, suggested to us the name of

## EOLIS CINGULATA.

*Hystrix*, under which we first published this species in the 'Annals of Natural History,' but finding since that the name had been previously used by M. Otto for an allied species found in the Mediterranean, we have now changed it to *cingulata*. The species of M. Otto has the branchial papillæ banded in a similar manner to ours, but they are more numerous, and arranged in ten dense rows. His figures appear to be taken from a spirit specimen, and there is no mention of colour in his specific character, but, according to M. Risso, the body is of a deep orange-colour when the animal is alive, and the papillæ banded with black and white. There can be no doubt, therefore, that ours is distinct. Upon this Mediterranean species Risso has founded his genus *Ethalion*, characterized in that author's usual vague manner. We have read over his generic character carefully, and must confess our inability to distinguish the genus from *Eolis*. The sole difference we find is that mention is only made of two tentacles. It is evident from his own specific description, however, as well as from the description and figure of M. Otto, that the animal really has four. The genus *Ethalion*, therefore, may be consigned to the oblivion it merits.

Figs. 1, 2, 3. *Eolis cingulata*, different views.  
4. Spawn.





## Fam. 3, Plate 29.

*Figs. 1 to 4.*

### EOLIS VITTATA, ALDER and HANCOCK.

*E. gracilis*, fulva, maculis ferruginosis; branchiis elongatis, sub-clavatis, pallidè fulvis vel carneis, cingulis 3 fuscis obscuris, apicibus flavidis, in seriebus 6-7 digestis; tentaculis fulvo-annulatis, apicibus albidis; angulis anterioribus pedis obtusis.

*Eolis vittata*, Ald. and Hanc., in Ann. Nat. Hist., v. 9, p. 35.

For. and Hanl., Brit. Moll., v. 3, p. 601.

*Hab.* On zoophytes from deep water, Cullercoats; rare.

*Body* nearly four tenths of an inch long, slender, buff or fawn-coloured, with darker spots and markings of the latter colour, especially on the head, and along the sides of the body at the bases of the branchiæ, where they form two broad interrupted lines. *Dorsal tentacles* rather long, linear, slightly wrinkled; fawn-coloured, with pale tips, and having a dull orange-coloured ring two thirds up; held nearly in an erect position. The eyes are placed at the base of these tentacles, but in front of them, and not behind, as usual. *Oral tentacles* shorter than the dorsal pair, coloured and banded in like manner, and inserted into the upper surface of the lip. *Head* rather large, and truncated in front. *Branchiæ* stout, long, and nearly linear, swelling a little towards the apex, which is obtuse: they stand very erect on the sides of the back, and radiate in the manner of the rays of a fan. They have the central gland of a rosy flesh-colour, delicately freckled and granulated with darker rose-colour. Each papilla has three brown bands, more or less distinct; that at the top being usually strongest, and forming a ring round the apex, which is pale yellow. The papillæ are arranged in eight or nine transverse rows, set considerably apart; there are from three to seven papillæ in each row. *Foot* transparent white; the angles obtuse and not much produced.

This beautiful animal has a considerable resemblance to *E. cingulata*, but the linear and subclavate branchiæ are sufficient to distinguish it. These never assume the ovate form of that species, even when contracted; their colour is also different. It may be remarked, too, that *E. vittata* carries the dorsal tentacles more erect than *E. cingulata*.

We have found three individuals of this species at different times on corallines brought in on the lines of the Cullercoats fishermen. They were all more or less injured, a circumstance unfortunately not uncommon, when these delicate and fragile creatures are obtained by that

## EOLIS VITTATA.

means. The colour and markings vary a good deal. In one of the specimens the tentacles were without bands, the glands of the papillæ were scarcely visible, and their tips were without colour. The lateral markings were also broken up into freckles.

The spawn taken along with one of the specimens was in the form of a riband attached by one of its margins to the stem of a coralline, and, being coiled, assumed the shape of a cup: the eggs were arranged in wedge-shaped masses.

Fig. 1. *Eolis vittata*, side view.

2. Two of the branchial papillæ, much enlarged.
3. Spawn.
4. A portion of the same, much enlarged, exhibiting imbedded ova.

## Fam. 3, Plate 29.

*Figs. 5 to 8.*

### EOLIS GLOTTENSIS, ALDER AND HANCOCK.

*E. gracilis*, viridi-lutescens; branchiis robustis, atro-viridibus, apicibus aureis, in seriebus 8-9 digestis; tentaculis longis, obtusis; angulis anterioribus pedis rotundatis.

*Eolis Glottensis*, Ald. and Hanc., in Ann. Nat. Hist., v. 18, p. 293.

For. and Hanl., Brit. Moll., v. 3, p. 601.

*Hab.* Dredged in Lamlash Bay, Arran, on *Pecten opercularis*, J. A.

*Body* about four tenths of an inch in length, pale greenish-yellow; not very slender. *Dorsal tentacles* of the same colour as the body, transparent, with opaque white spots, rather long, linear, smooth, a little thickened at the top, and approximating at the base. *Oral tentacles* about two thirds the length of the dorsal pair, which they resemble in form and colour. They are set on the upper side of the lip, and are generally held in a curved position. Outline of the head semicircular. *Branchiæ* rather short and stout, the central gland of a dark bottle-green approaching to black above, granulated, nearly filling the sheaths; the apices are deep orange or golden-yellow, with sometimes a narrow yellow ring below; the extreme tips are transparent and rather blunt. They are arranged in eight or nine rows on each side of the back; the three front rows very close together; with a little space between them and the fourth. There are four or five papillæ in each row, excepting behind, where they diminish to two, coming very near to the tail. *Foot* transparent yellowish-white, with a deep notch in front, the angles slightly produced and rounded. It terminates posteriorly in a blunt point.

We procured a single specimen of this *Eolis* in June, 1846, while dredging, in company with our friends, the Rev. Dr. Landsborough and his son, in Lamlash Bay, Isle of Arran. From the heat of the weather at the time we were unable to keep it alive over the night.

*Eolis Glottensis* comes nearest to *E. arenicola* of Forbes, which it resembles a good deal in colour, but the proportions of the parts and number of branchiæ are so different that we think ourselves warranted in considering them distinct.

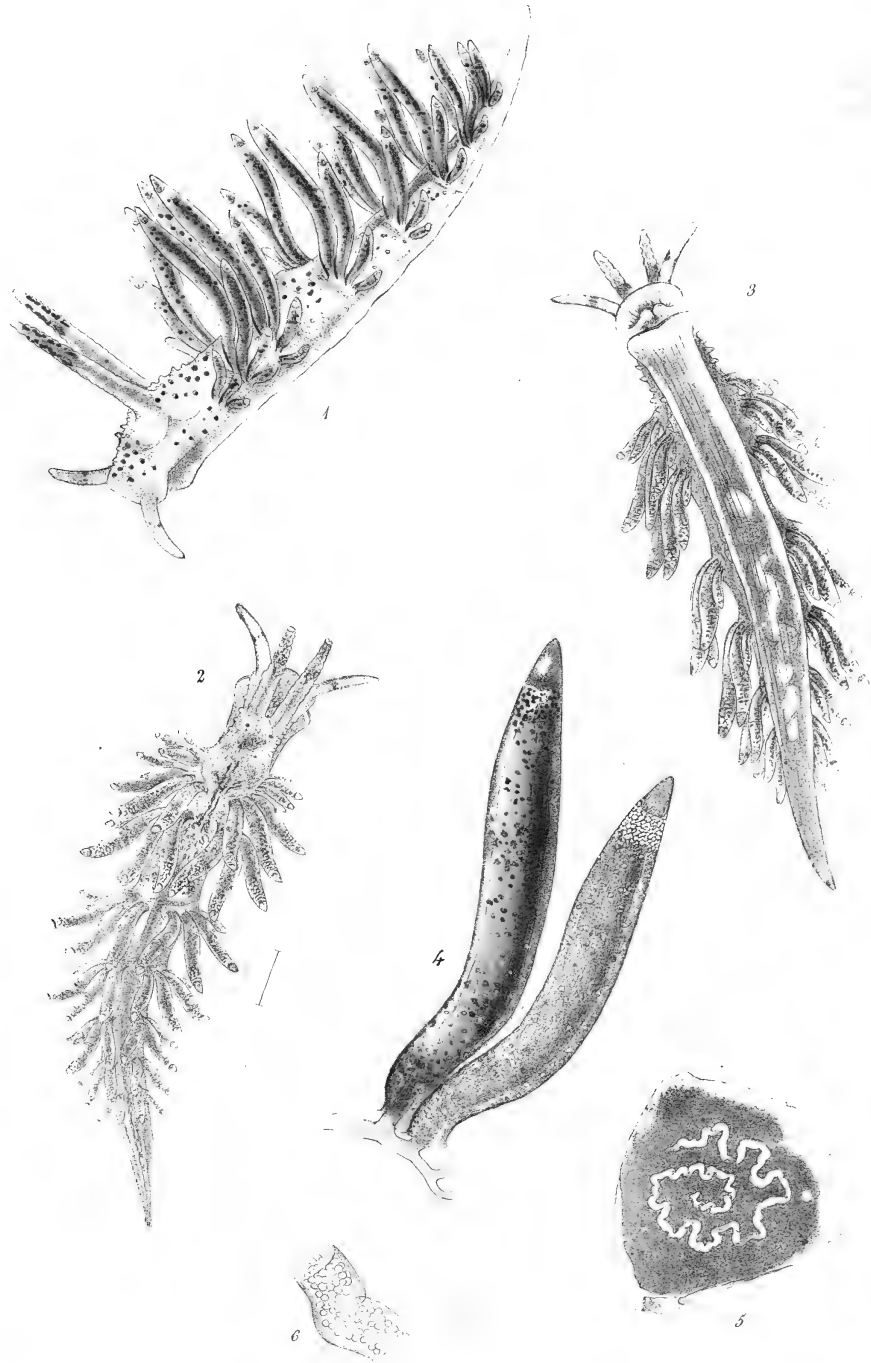
Figs. 5, 6, 7. *Eolis Glottensis*, different views.

8. One of the branchial papillæ, much enlarged.









A. H. del.

C. Hullmandel's Patent Lithogr.

*Elysia amona*.

### Fam. 3, Plate 30.

#### EOLIS AMÆNA, ALDER and HANCOCK.

*E. gracilis*, virescenti-alba, brunneo notata, punctis albis: branchiis viridibus, luteo-maculatis, in seriebus 8 digestis, quorum 3, contiguæ et 5 remotæ sunt: tentaculis dorsalibus longis, brunneo-cinctis: lateribus anterioribus pedis rotundatis.

*Eolis amæna*, Ald. and Hanc. in Ann. Nat. Hist. v. 16, p. 316.

*Hab.* Dredged in Torbay.

*Body* about three lines long, slender, nearly linear, terminating behind in a fine point; of a greenish white, tinged with yellow from the viscera appearing through; on the back are a few dark brown markings. The head and shoulders are sprinkled with opaque white tubercles, and there is a faint streak of white on the tail. *Dorsal tentacles* long, linear, wrinkled, pellucid, slightly tinged with green and thickly spotted with white near the top: about one third down they are encircled by a dark brown band. They are set rather close together at the base, and held nearly parallel: the eyes are rather small and situated close behind them. *Oral tentacles* about half the length of the dorsal ones, linear, arising from the upper surface of the lips, whitish with an imperfect brown band in the centre; the tips obtuse. *Branchiæ* arranged in eight transverse rows on each side, the three anterior ones close together, the others wide apart. The first row contains three small papillæ, most of the others have four papillæ each; those next the back longest, the outside ones very small. They are large, linear, slightly elliptical, and pointed above, standing up in a fan-like manner across the back: the central vessel is of a pale warm green, and nearly fills the sheath, which has a brown ring at the base and some pale freckles of the same colour apparently arranged in three belts above; the surface is likewise freckled with pale opaque yellow spots, crowded near the top, where they form an indistinct ring: the tip is transparent. The gastric vessel is seen of a green colour through the skin on the centre of the back, with branches along the base of the papillæ. *Foot* very narrow, linear, the anterior margin slightly bilobed and a little widened and rounded at the sides: the tail terminates a short way behind the branchiæ.

So nearly do the species of this genus approach each other, that it is often difficult to point out the characters by which they may be distinguished. A difficulty of this kind occurs to us in comparing this lovely little species with the *Eolis (Montagua) viridis* of Forbes. There are several small differences in colour and markings, but perhaps the best distinguishing characters are to be found in the close approximation of the first three rows of papillæ in *E. amæna*, and the brown markings on the back. The tubercular nature of the spots on this little animal is different from anything we have before observed in the genus. This species is also nearly allied to *E. Northumbrica*, from which, in addition to the

EOLIS AMÆNA.

characters already pointed out, it differs in the form of the papillæ and the greater length of the dorsal tentacles.

Two specimens were taken by the dredge in Torbay, in the months of May and June, 1845. They were rather inactive, and made very little progress when swimming. The foot seems well adapted for grasping corallines, but scarcely fitted for moving on a plain surface.

The spawn is white and deposited in a waved thread, forming a spiral of two or three turns.

- Fig. 1, 2, 3. *Eolis amæna*, different views.  
4. Two of the papillæ more highly magnified.  
5. Spawn.  
6. A portion of the same more highly magnified.





A. Hancock del. A. Holmes lithot.

C. Hullmandel's Patent.

Fig. 1. EOLIS ARENICOLA Fig. 2 & 3 EOLIS NORTHUMBRICA.

Fam. 3, Plate 31.

Fig. 1.

EOLIS ARENICOLA, FORBES, M. S.

*E. alba*: branchiis linearibus atro-viridibus, apicibus flavis, in seriebus 15 digestis: tentaculis linearibus flavis: angulis anterioribus pedis subrotundatis.

*Hab.* Dredged in ten-fathoms water, on weedy ground, at the entrance of Menai Straits. *Prof. E. Forbes.*

*Body* about three quarters of an inch in length, slender, white. *Dorsal tentacles* long, linear, smooth, and tapering; pale yellow, a little deeper towards the top. Eyes small, situated behind them. *Oral tentacles* rather shorter than the dorsal pair, and of a similar form and colour, placed on the upper part of the lip, which is semicircular, margined with yellow. *Branchiæ* rather long, linear, and tapering at the top; the central vessel of a dark bottle-green, irregular in its outline, much narrower than the sheaths, and extending about two thirds up, above which the papillæ are of a pale yellow, with the extremities colourless. There are fifteen rows, of three or four papillæ each, on each side; the central ones are long, and those at the sides very small and clavate, and more numerous; the uppermost, when there are four, are also small and irregular. *Foot* linear, squared in front, with the angles slightly rounded off, and tapering to a fine point a little beyond the branchiæ behind.

This fine species was dredged off the Isle of Anglesea by Professor E. Forbes, in the summer of 1844. Our drawing is taken from the sketches of that gentleman, kindly placed in our hands for the purposes of this work.

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Fam. 3, Plate 31.

Figs. 2 and 3.

EOLIS NORTHUMBRICA, ALDER and HANCOCK.

*E. gracilis*, sub-viridè alba: branchiis subclavatis, viridibus, apicibus albis, in seriebus 9 remotis digestis: tentaculis dorsalibus, subannulatis: lateribus anterioribus pedis paululum productis, rotundatis.

*Eolis Northumbrica*, Ald. and Hanc. in Ann. Nat. Hist. v. 13, p. 165.

*Hab.* On a coralline from the fishermen's lines, Cullercoats, A. H.

*Body* a quarter of an inch long, slender, transparent, of a delicate pale green. *Dorsal tentacles* rather long, cylindrical, abruptly truncated; the upper half white, with a few

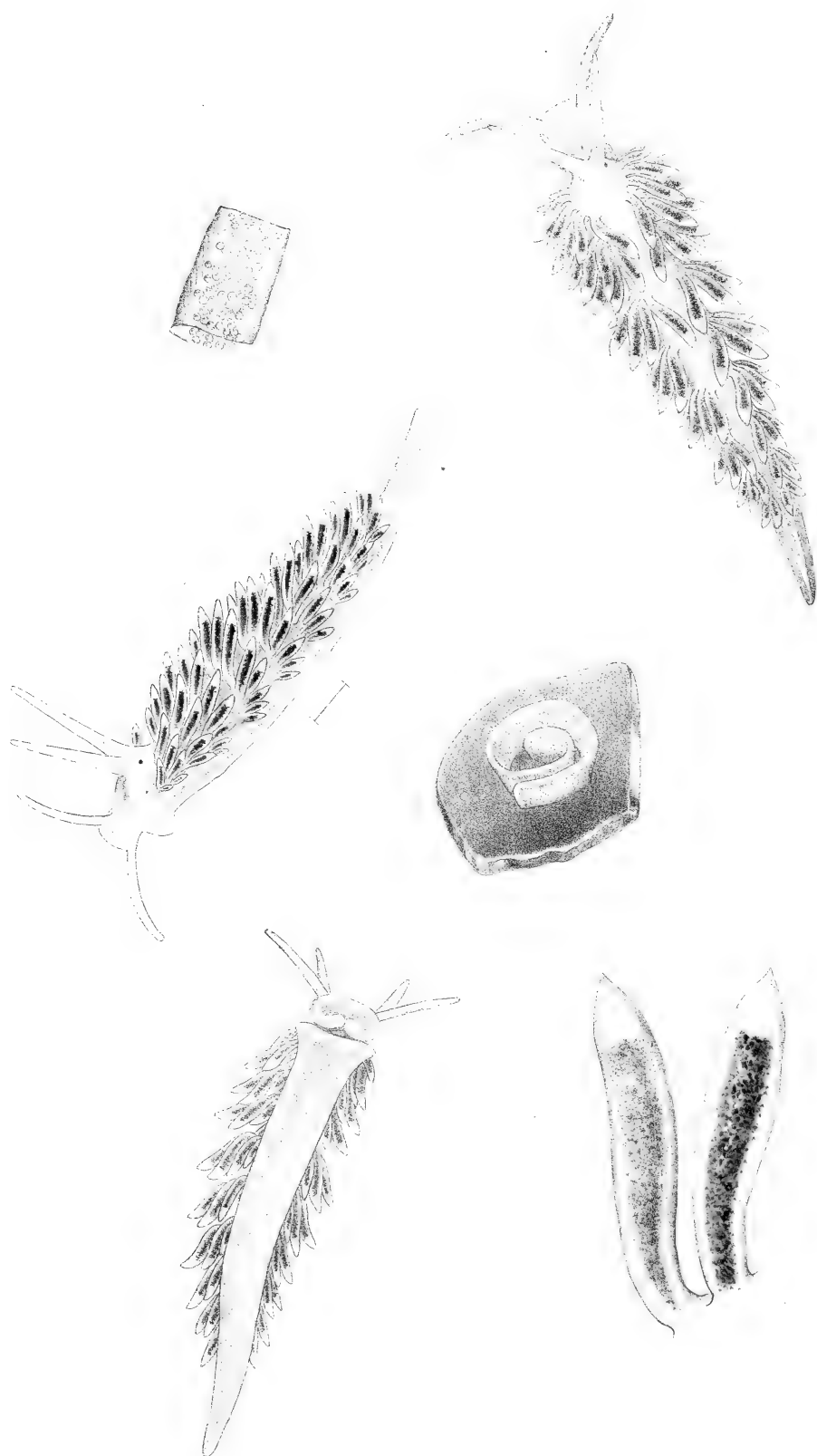
## EOLIS NORTHUMBRICA.

irregular rings, and the bases set a little apart. *Oral tentacles* as long as the dorsal ones, and like them abruptly truncated and white at the extremities. *Branchiæ* subclavate, and of a cold bluish green with white tips; the coloured vessel is granular, and does not entirely fill the sheaths. They are set in nine transverse rows, far apart from each other, and divided down the back: the three anterior rows are nearer together than the rest. The first and second rows have three papillæ each, the third five, and the two or three following four each; the rest gradually diminishing towards the tail. From the transparency of the skin a green internal line is visible down the back, marking the direction of the central vessel of the digestive system, from which branches are seen going off into the papillæ; there is also a darkish lozenge-shaped spot immediately in front of the dorsal tentacles. *Foot* extending a little way further than the termination of the branchiæ behind; the anterior angles not much produced and somewhat rounded.

A single specimen only of this species has been obtained, but as it lived several days with us, we were enabled to complete a careful drawing and description. It approaches very near to the *Montagua viridis* of Forbes, but differs in the character of the dorsal tentacles and branchial papillæ. In *E. Northumbrica* the former are linear, and have the upper portion annularly wrinkled or ringed, which gives them the appearance of swelling a little towards the tip. In *E. viridis* these organs taper gradually, and are without rings or wrinkles. The papillæ of *E. Northumbrica* are of a much darker colour, less granular, considerably larger, and are carried more erect, and in a radiating manner, whilst in *E. viridis* they incline more backwards in the usual way, are nearly linear or slightly elliptical, and taper at the points. The differences between this and *E. amæna* have been already pointed out in our description of that species.







## Fam. 3, Plate 32.

### EOLIS VIRIDIS, FORBES.

*E. gracilis*, viridi-albida; branchiis linearibus, acutis, viridibus, apicibus albis, seriebus 10 subremotis digestis; tentaculis linearibus, lævibus, æqualibus; lateribus anterioribus pedis subproductis.

*Montagua viridis*, Forbes, in Ann. Nat. Hist., v. 5, p. 106, pl. 2, f. 18.

*Eolis viridis*, For. and Hanl., Brit. Moll., v. 3, p. 603, pl. BBB, f. 3.

*Hab.* In twenty fathoms water, Isle of Man, and twenty-five fathoms, Cornwall, *Professor E. Forbes*. Saltcoats, and Portincross, Ayrshire, *Rev. D. Landsborough, jun.*

*Body* three tenths of an inch long, slender, white tinged with yellowish-green. *Dorsal tentacles* rather long, linear, smooth, greenish white. Eyes very conspicuous at their posterior base. *Oral tentacles* linear, about the same length as the dorsal pair, set on the upper surface of the lip; ends blunt. *Branchiæ* nearly linear, rather stout, somewhat abruptly pointed; the central gland of a bright bluish-green, varying to grass-green and bottle-green, and always much and strongly spotted with darker granules; the sheath is much wider than the gland, and the surface is sprinkled with opaque white spots, most numerous down the front; the apices are opaque white, apparently from the opacity of the ovate vesicle, which is very large, and not, as usual, from a white ring on the surface. The papillæ are set in ten rather distant rows, the four anterior rows being a little closer than the rest, and the first approaching to the sides of the dorsal tentacles. The rows contain from four to seven papillæ each, diminishing in size as they approach the foot. *Foot* yellowish white, slightly indented in front, a little produced and obtuse at the sides, tapering to a point behind a little beyond the branchiæ.

*Eolis viridis* was first obtained by Professor E. Forbes on an *Antennularia* dredged in deep water off Ballaugh, Isle of Man, and the same distinguished naturalist has since met with it on the coast of Cornwall. We have had it twice sent to us alive by the Rev. David Lansborough, jun., from the Ayrshire coast, where it was found at low-water mark. A specimen, which spawned with us in April, 1847, shows the spawn to be of a flattened form, attached by one of its edges, and forming a coil of nearly two volutions. The eggs are pale yellow, and are promiscuously scattered through the gelatinous envelope.

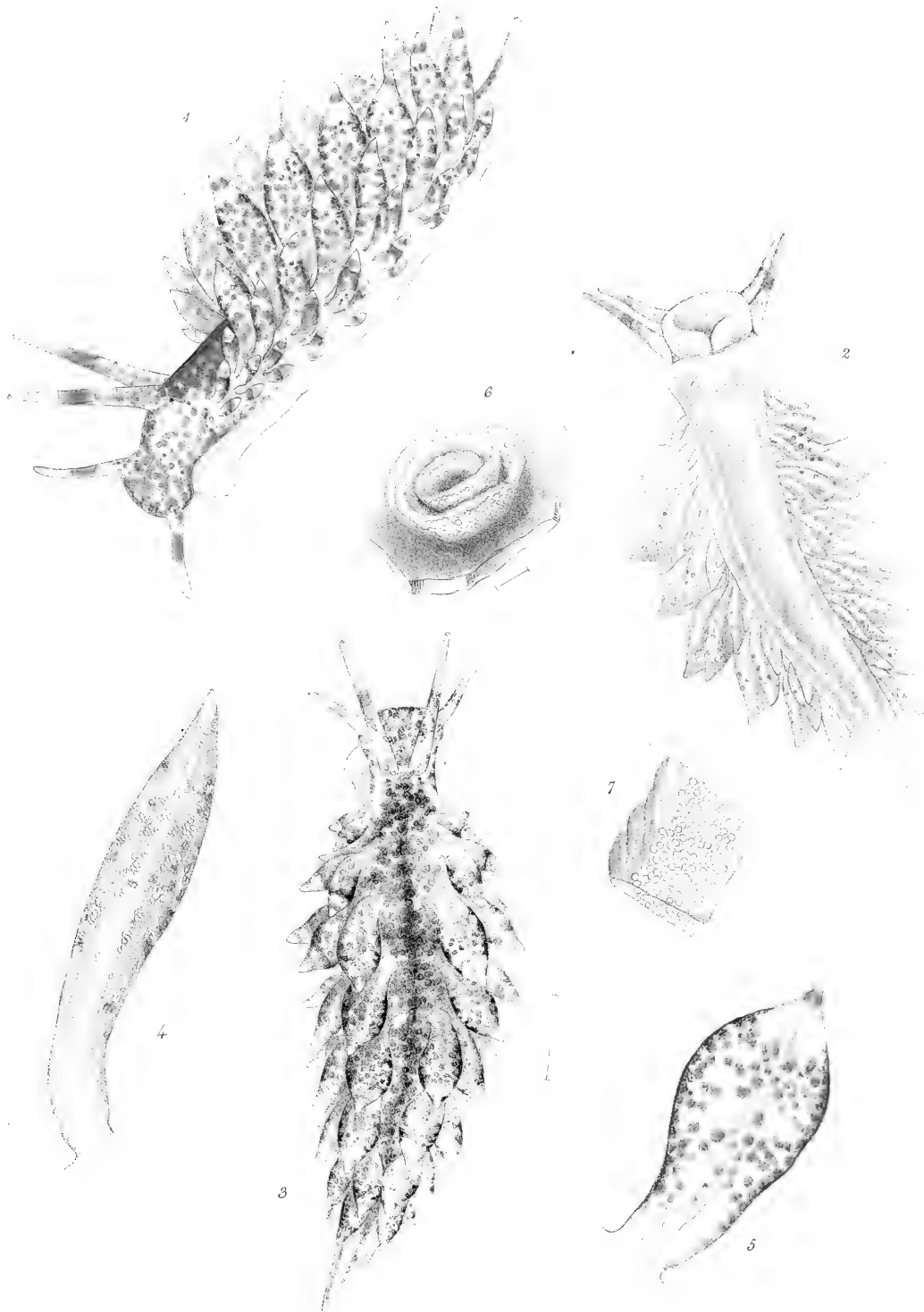
Figs. 1, 2, 3. *Eolis viridis*, different views.

4. Two of the branchial papillæ much enlarged.

5. Spawn.







A. Hancock del. A. Holmes lithotint.

C. Hullmandel's Patent.

EOLIS PICTA

## Fam. 3, Plate 33.

### EOLIS PICTA, ALDER and HANCOCK.

*E. alba*, maculis fulvis et albis opacis aspersa: branchiis ovalis, inflatis, fulvo maculatis; in seriebus 7-8 digestis: tentaculis fulvo-cinctis: lateribus anterioribus pedis rotundatis.

*Eolis pallida*, Ald. and Hanc. in Ann. Nat Hist. v, 9, p. 35.

*Hab.* Among rocks near low-water mark. Whitley, Cullercoats, and Newbiggin, Northumberland. Malahide Bay, near Dublin. Torbay. Menai Straits, *Professor E. Forbes*.

*Body* about half an inch long, transparent white with a tinge of yellow, spotted with rich orange-brown on the head and shoulders, and along the back, where the spots, which are generally circular, frequently coalesce. The head is also spotted with opake white. *Dorsal tentacles* long, slightly tapering, smooth, transparent, with a band of orange-brown about half-way down, and spotted with the same colour, and opake white. *Oral tentacles* linear, much shorter than the dorsal ones, transparent white, with a few orange-brown and opake white spots, and a band of orange-brown near the centre. *Branchiæ* ovate, much inflated, and terminating in a slender pale point, frequently with a faint yellowish ring near the apex. They are spotted with opake white and orange-brown, the central vessel being of a delicate pale buff. This vessel is very small in comparison with the papillæ, and is slightly elliptical, with the margins irregularly sinuous. The papillæ are very various in size, those near the centre of the back being very large, and those near the foot very small. They are set in seven or eight transverse rows of five or six each down the sides of the back, leaving a considerable naked space behind the dorsal tentacles. *Foot* transparent white, not much produced beyond the branchiæ behind, and terminating rather obtusely; the anterior extremity enlarged, rounded at the sides, and slightly bilobed.

At the time when we published the description of this species in the 'Annals of Natural History,' we had only seen a single specimen, which proved to be a pale variety, and by no means characteristic of its usual appearance. Since then we have met with many examples, some of them so brilliant in colour, that the name of *pallida* cannot properly be applied to them. We have therefore substituted that of *picta*. Sometimes specimens occur nearly without spots, but more frequently the spots are numerous and of a rich orange-brown colour, or occasionally of a rosy hue. In finely developed individuals, the markings are often very dark and dense, particularly on the back.

*Eolis picta* is a fine species,—remarkable on account of its large dorsal papillæ which have a leaf-like outline. The spawn is deposited on the under side of stones. It is white, and has considerable resemblance to that of some of the *Dorididæ*, having the eggs inclosed

EOLIS PICTA.

in a strap-shaped gelatinous covering attached by its edge, and forming a shallow cup of about two coils.

Figs. 1, 2, 3. *Eolis picta*, different views.

4. A papilla much elongated.

5. A papilla much inflated.

6. Spawn.

7. A portion of the same more highly magnified.







### Fam. 3, Plate 34.

#### EOLIS TRICOLOR, FORBES.

*E. ovato-oblonga*, pallidé flavida; branchiis elliptico-oblongis, inflatis, albis, lineâ centrali violaceâ, apicibus flavo-annulatis, in seriebus 13-14 digestis: tentaculis fulvis; lateribus pedis anterioribus rotundatis.

*Eubbranchus tricolor*, Forbes, Mal. Mon. p. 5.

*Eolis violacea*, Ald. and Hanc., in Ann. Nat. Hist. v. 13, p. 166.

*Hab.* On corallines from deep water (15 to 20 fathoms). Ballaugh, Isle of Man, and coast of Anglesea, Professor E. Forbes. Belfast Lough, W. Thompson, Esq. Cullercoats, Northumberland.

*Body* above an inch long, ovate-oblong, rather broad, and not much produced behind, of a pale buffish yellow, tinged on the head with orange or fawn-colour. *Dorsal tentacles* fawn-coloured, long and rather stout, tapering to an obtuse point. *Oral tentacles* much shorter and smaller, inserted into the upper surface of the lips, and faintly tinged with fawn colour. *Branchiæ* large, elliptical, inflated, pellucid, yellowish white with the central gland linear and of a deep violet colour, fading off to brownish orange below: an opaque ring of brilliant golden yellow encircles the apex. They are set in 13 or 14 transverse rows, leaving only a small space uncovered on the centre of the back. There are 3 to 5 papillæ in a row on each side, those next the back large and inflated, diminishing towards the sides, and very small near the foot. A few papillæ run along the sides as far as the dorsal tentacles. *Foot* rather broad, pellucid, terminating rather abruptly in a point not much behind the branchiæ. The front margin is grooved transversely and rounded at the sides.

This delightful species was first discovered by Professor E. Forbes on the coast of the Isle of Man, and published in his *Malacologia Monensis*, under the name of *Eubbranchus tricolor*. Subsequent observations, however, have shown that it really belongs to the genus *Eolis*, and that the individual first observed had been in a young and imperfect state. We met with a single specimen at Cullercoats, in October 1843, which, not recognizing its identity with *Eubbranchus tricolor*, we published under the name of *E. violacea*. Since then we have had a specimen sent us from Belfast Lough, by Mr. Thompson, and Professor Forbes procured several splendid specimens by dredging on the Anglesea coast, some of which he has kindly presented to us.

Mr. Forbes remarks, in his manuscript notes with which we have been favoured, that this animal when teased rolls itself up into a ball; a habit which we had not observed.

The eyes may very readily be seen in good specimens. The auditory capsule contains only a single otolite.

Fig. 1, 2, 3. *Eolis tricolor*, different views.  
4. Papillæ more highly magnified.







### Fam. 3, Plate 35.

#### EOLIS FARRANI, ALDER and HANCOCK.

*E. alba*; branchiis flavido-albis, inflatis, extremitatibus aurantio-annulatis, in seriebus 9-10, digestis: tentaculis supernè aurantiacis: lateribus pedis anterioribus rotundatis.

*Eolis Farrani*, Ald. and Hanc. in Ann. Nat. Hist. v. 13, p. 164.

*Hab.* One specimen brought up by the dredge in Malahide Bay, near Dublin.

*Body* three-eighths of an inch long, slender, tapering to a fine point behind, pellucid white, with a delicate tinge of yellow. There are a few spots of bright orange immediately before and behind the dorsal tentacles, and on the medial line of the back extending towards the tail, at the extreme point of which is a blotch of the same colour. *Dorsal tentacles* rather long, smooth, nearly linear, swelling slightly towards the base, where they approximate. The lower portion is transparent white; the upper portion orange, excepting the tips which are whitish. *Oral tentacles* about half the length of the dorsal ones, and of the same colour; rather slender, linear, inserted into the upper surface of the lips. *Head* rather narrow and roundish, the lips not much spreading at the sides. *Branchiæ* elliptical, inflated, pellucid white, with the central vessel of a pale straw colour, giving the whole a yellowish white appearance. They are terminated by a broad ring of bright orange, with occasionally a few dusky freckles; the apex transparent. They are set in nine or ten transverse rows of three or four papillæ each, on the sides of the back, nearly approaching in the centre, where they are large and inflated; those next the sides small. The first row, containing two papillæ, approaches very close to the dorsal tentacles. *Foot* linear, tapering gradually to a fine point posteriorly; pellucid; the spawn and viscera appearing through; anterior portion not much extended laterally, but rounded and slightly bilobed in the centre.

We have named this pretty species after Dr. Farran of Dublin, a gentleman well known for his love of natural history, and for his fine collection of Irish shells. To him we are indebted for the opportunity of procuring this and two other new species of Irish Nudibranchs dredged during a little excursion to Malahide in August 1843.

The single specimen captured, lived with us a considerable time, and was almost constantly in motion. The spawn is in form of a broad gelatinous riband, attached by its edge, and coiled openly one and a half times.

This species is very nearly allied to *E. tricolor*, but is much more slender, and has the head narrower and more elegantly formed; the branchiæ are rather shorter; their central

EOLIS FARRANI.

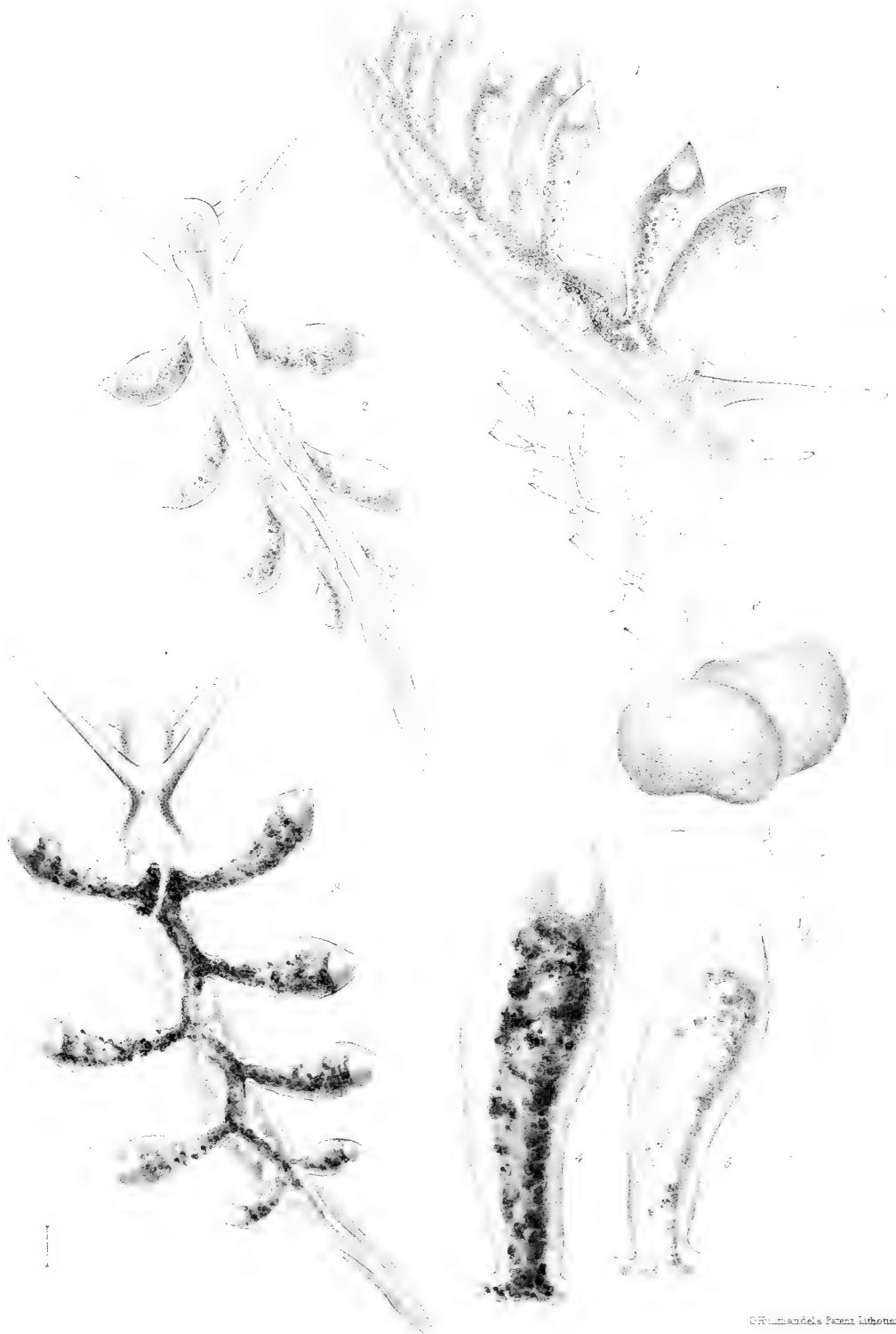
vessel, in this species, is of a pale straw colour, elliptical and deeply sacculated, while in *E. tricolor*, the same vessel is violet-coloured and nearly linear.

The little animal for which M. de Quatrefages has instituted his genus *Amphorina*, looks very like the young of this species.

- Fig. 1, 2, 3. *Eolis Farrani*, different views.  
4. Spawn.  
5. Papillæ more highly magnified.







C. H. Mandel's Press Lithour.

ECLIS DESPECTA

## Fam. 3, Plate 36.

### EOLIS DESPECTA, JOHNSTON.

*E. alba*, lineâ olivaceâ undatâ in medio dorsi; branchiis amplis, ovatis, in serie unicâ utrinque digestis: tentaculis dorsalibus longis, lateribus pedis anterioribus non productis.

*Eolidia despecta*, Johns. in Mag. Nat. Hist. vol. 8, p. 378, fig. 35e: idem in Ann. Nat. Hist. vol. 1, p. 123.

*Hab.* On corallines at or beyond low-water mark. Berwick Bay, Dr. Johnston. Whitley, Northumberland. Oban, Argyleshire.

*Body* two or three lines long, slender, tapering gradually to a point behind; transparent white with a slight greenish tinge in the centre from the viscera shining through. Two reddish streaks pass backwards from the dorsal tentacles towards the first branchial papillæ, and two fainter ones also pass forward to the oral tentacles; besides these there is a streak of pale red on each side of the body below the branchiæ. These reddish markings are, however, sometimes wanting. *Dorsal tentacles* long, tapering, smooth, and stout, approximating at their bases, but generally spread much apart and inclined forwards; pellucid, with the red streak of the head and shoulders passing a little way upwards. The oral pair short, not above one third the length of the dorsal ones, linear and pellucid. *Branchiæ* large, oblong-ovate, pointed, forming a single line of four papillæ on each side of the back. The first pair are opposite each other, the rest alternating. The central part of each papilla is of a pale olive green or yellowish brown, coarsely and irregularly granulated with a much darker shade of the same colour; the outside rim whitish and transparent; the tips opaque white, with sometimes a reddish band. A dark vessel of the same colour as the branchiæ, and similarly granulated, is seen passing down the centre of the back in a zig-zag line sending off a branch into one of the papillæ on each side alternately at the angles. *Foot* very narrow, tapering to a point behind, and extending considerably beyond the papillæ; the front is rounded and not produced at the sides. The eyes are small.

The specimen from which Dr. Johnston's description of this pretty little species was taken had only three papillæ on each side, and was probably a young one. It is subject to a little variation in colour and markings; some individuals being very pale, while others have the red or olive markings more or less conspicuous. The very large and undulating central branch of the digestive system is lined with coloured granules, and has in all probability the same function to perform as the glands of the papillæ. It may therefore be considered a portion of the hepatic organ. In this peculiarity, as well as in its general aspect, this little creature shows a departure from the type of *Eolis*. It appears nearly allied to the *Limax tergipes* of Forskal, upon which Cuvier founded his genus *Tergipes*; but that eminent naturalist was, we think, led into an error by relying upon the structure and func-

## EOLIS DESPECTA.

tion attributed to the branchial papillæ, the chief character on which his genus rests. Forskal's statement we conceive to have originated in a mistake. More than one naturalist has been deceived by the transparent tips of the papillæ in *Eolis*, which being generally surrounded by an opaque ring, have the appearance, when looked down upon, of being hollow.

*Eolis despecta* is a gregarious animal; 18 or 20 specimens were found under the same stone at Whitley rocks. They had deposited their spawn on a small coralline (*Laomedea gelatinosa*) that covered the under side of the stone. In Oban Bay they were met with in yet greater numbers on *Laomedea geniculata* attached to the large fronds of *Laminaria saccharina* dredged up in five or six fathoms water. In the latter place we should think a hundred specimens might readily have been obtained in a short time: they were also spawning. The spawn, which in both cases was met with in the month of June, is a small kidney-shaped mass; the ova inclosed in a thick transparent envelope. Its form differs from that of any other species we have met with.

A few individuals kept for several days we found to be very active and restless in their habits, and fond of swimming inverted on the surface of the water. The vibratile cilia on the body of this species are larger than usual.

Fig. 1, 2. *Eolis despecta*.

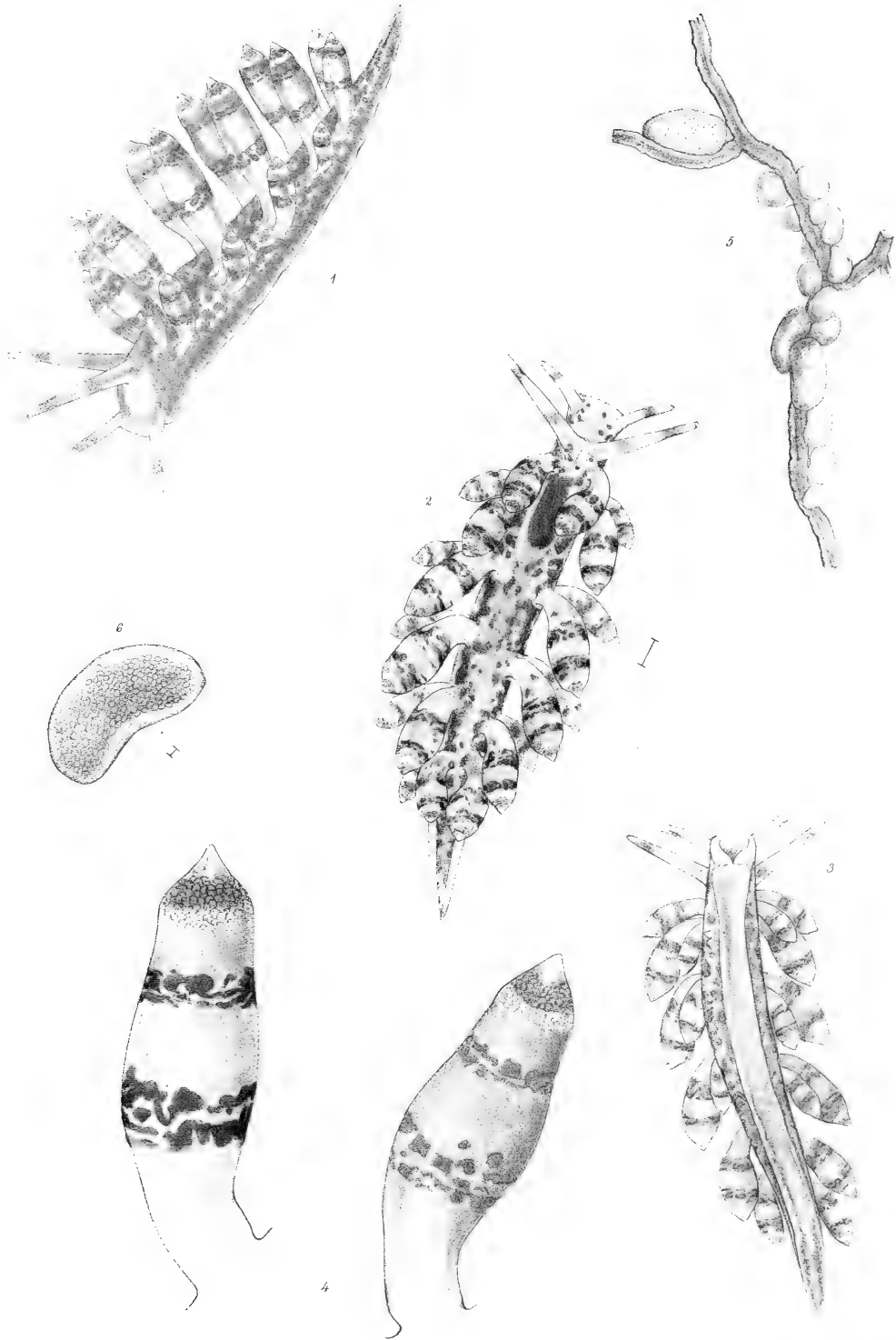
3. The same, dark variety, with the papillæ encircled with red.

4, 5. Papillæ more highly magnified.

6. Spawn.

(The figures in this Plate have inadvertently been reversed.)





A Hancock del W Wing lith.

C Hullmandel's Patent Litho int

*EOLIS EXIGUA.*

### Fam. 3, Plate 37.

#### EOLIS EXIGUA, ALDER and HANCOCK.

*E. parva*, luteola, fusco vel olivaceo marmorata; branchiis magnis, ovatis, fusco cinctis, unicâ, binâ, aut triplici serie utroque dorsi latere digestis; tentaculis dorsalibus longiusculis; tentaculis labialibus brevibus, utrisque fusco cinctis; angulis anterioribus pedis brevibus, obtusis.

*Eolis exigua*, Ald. and Hanc., in Ann. Nat. Hist., 2d. ser. v. 1, p. 192.

*Tergipes lacunculatus*, Lovén, Ind. Moll. Scand., p. 7.

*Hab.* Upon fuci and corallines in shallow water. Fowey Harbour, Cornwall, J. A. Falmouth, W. P. Cocks, Esq.

*Body* scarcely exceeding two tenths of an inch in length, slender, transparent, yellowish white, with sometimes a tinge of green. There is generally a large oval spot on the back between the first rows of branchiæ, with several smaller spots behind, and a broad interrupted band down each side between the bases of the papillæ. *Dorsal tentacles* longish, linear, inclining forwards, diverging much above, and approaching each other at the base, encircled near the top with a brown or olive band. There is sometimes a second indistinct band below. *Oral tentacles* not above half the length of the upper pair, similarly banded, rather obtuse, and inserted on the upper surface of the lip. *Branchiæ* large, clavate, and much inflated, tapering abruptly to a point. They are almost colourless, the central vessel giving them a slight yellowish tinge; the surface is marked with two interrupted belts of brown, or olive green, sometimes indistinct, or forming only detached spots; and the apex is encircled with a reddish or brownish ring; immediately below which, and running into it, is a circle of white. The red portion is frequently wanting. These circles, when examined with a lens of moderate power, appear minutely granular. There are frequently only five or six papillæ in single series on each side of the back, but in full-grown individuals the first row often consists of three papillæ, and the second and third of two each. In the specimen figured, which was one of the finest obtained, the double series extends to the third row: this, however, is unusual. The first rows are placed opposite each other, the rest alternate. *Foot* narrow, transparent, and nearly colourless; the front is truncated, and not produced at the sides, the posterior extremity obtusely pointed, and extending only a little beyond the branchiæ.

We got this pretty little mollusk in June, 1847, in considerable abundance on the large fronds of *Laminaria saccharina*, dredged in shallow water in the beautiful harbour of Fowey. From its diminutive size, it was very difficult of detection; but by careful search it might generally be found on those parts of the frond that were clothed with *Laomedea geniculata* and other small parasitic zoophytes, among the fibres of which it nestled. Frequently, too, the zoophytes were profusely studded with its spawn, in small oval patches, which, from the

## EOLIS EXIGUA.

whiteness and opacity of the ova, were more conspicuous than the animals themselves. A few specimens of *Eolis despecta* were found accompanying them. These were readily distinguished by their waved dorsal line.

*Eolis exigua* is active in its habits, and, when kept in a glass of sea-water, is fond of swimming on the surface. It is the *Tergipes lacinulatus* of Lovén's 'Index,' but we do not agree with the learned author in referring it to the *Limax tergipes* of Forskal (*Doris lacinulatus*, Gmel.), which species, as far as we can judge from the imperfect description and very rude figures, is more likely to be the *Tergipes bullifer*, Lov., a view which we believe M. Lovén is now inclined to take. We think, however, that it would be better to give up the attempt to identify the lost species of early naturalists when they are so imperfectly described as to allow only of a probable conjecture.

- Figs. 1, 2, 3. *Eolis exigua* in different positions.  
4. Two of the papillæ more highly magnified.  
5. Several masses of spawn investing a coralline.  
6. A single mass more highly magnified.



#### GENUS 14. EMBLETONIA, ALDER and HANCOCK.

*Corpus* elongatum, limaciforme, non palliatum. *Caput* terminale, lateribus utrinque in lobum planum extensis. *Tentacula* 2, linearia, sublateralia. *Maxillæ* corneæ. *Branchiæ* papillosæ, ad latera dorsi, ut plurimum in simplici serie, utrinque dispositæ. *Anus* et orificium generationis ad latus dextrum.

We described this genus in the 'Annals of Natural History' for November, 1844, under the name of *Pterochilus*; but having since ascertained that the name has been already used for a genus of Hymenopterous insects, we now propose to substitute for it that of *Embletonia*, in honour of our friend Dr. Dennis Embleton, from whom we have received such able assistance in the anatomical part of this work. The genus is closely allied to the *Eolides* of our fourth section; but differs from them in having only two tentacles, the oral pair being here supplied by an expansion of the sides of the head into flattened lobes. The dorsal tentacles, too, are placed much more laterally than in *Eolis*, and at a greater distance from the eyes. There is at present only one ascertained British species, unless the small nudibranch, noticed under the name of *Eolidia minuta* by Professor E. Forbes at the Birmingham meeting of the British Association in 1839,\* should prove to be distinct from that here described. Two American species of the genus have been discovered by Dr. Gould of Boston, which, as far as we know, remain yet unpublished. The *Tergipes adspersus*† of Nordmann, which is described as having the oral tentacles triangular, appears to be closely allied to *Embletonia*. The species are all minute, and belong to the littoral and laminarian zones. There can be little doubt that they are carnivorous.

The body in this genus is elongated and nearly linear, tapering behind. The head is terminal and furnished with two flattened lobes, broadly expanded laterally, and forming a kind of veil. The mouth is inferior; it has large corneous jaws, and a narrow denticulated tongue. The tentacles are two in number, linear, generally short, and placed very much apart towards the sides of the head. The eyes are situated considerably behind them. The branchiæ are papillose, as in *Eolis*, and are generally placed in single series down each side of the back, alternating posteriorly. The great central hepatic vessel, partaking of the colour of the branchiæ, may usually be seen undulating down the back. In the American species there is more than one row of papillæ on each side. The foot is linear, truncated in front, and without any lateral expansion. The anus is placed on the right side, a little behind the generative organs, which are situated below and between the first and second papillæ.

Its anatomical characters, as far as they have been ascertained, are as follow:—The oral opening is beneath in the form of a longitudinal slit between two narrow lateral lips. The buccal organ is provided with a pair of large corneous jaws (Pl. 38, fig. 5) of a

\* See 'Athenæum' for August 31, 1839.

† Ann. des Scien. Nat., 3d ser. v, p. 110.

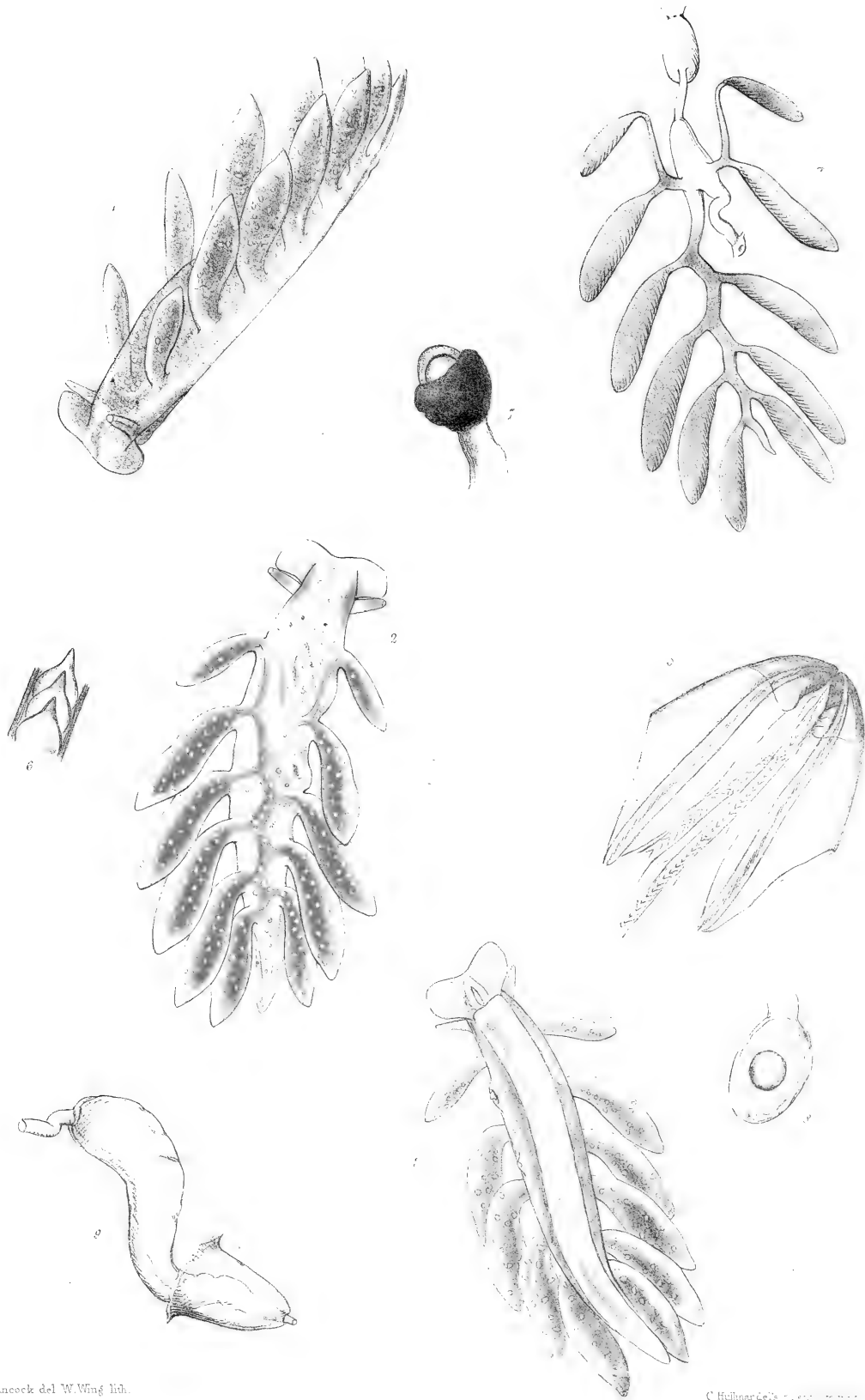
## EMBLETONIA.

triangular form, each apparently consisting of two parallel plates, and furnished at the anterior angle with a cap, the whole being similar to the jaws of *Proctonotus*. Something like a denticulated cutting edge was observed in front. Within the jaws is placed a long strap-formed tongue, composed of about sixty plates in *E. pulchra*, each (fig. 6) bearing a single, stout, recurved central spine: there are no lateral spines. The œsophagus and stomach (fig. 4), which were only indistinctly observed, do not appear to vary materially from those organs in *Eolis*, though perhaps the digestive sac is more backward in position than usual, consequently the œsophagus is rather long. The intestine is short, and passes in a slightly sinuous course from the upper surface of the stomach to the anal outlet near the third papilla on the right side. Two rather slender hepatic vessels arise from the dorsal aspect of the gastric pouch, one from each side, and, passing forward, branch into the two anterior pairs of papillæ, which are symmetrically arranged. The posterior extremity of the stomach receives a stout, central, hepatic vessel, which zig-zags down the median line of the back, immediately below the skin, giving a branch from the angles on each side to the papillæ; hence those of the two sides alternate. The whole of the hepatic vessels and their branches are of a colour resembling that of the papillary gland, which is large, almost filling the external sheath. There is no ovate vesicle in the apex of the papillæ, nor are we able to say that there is any external opening in that part. The body is covered with vigorous vibratile cilia; cilia likewise clothe the surface of the papillæ.

The reproductive organs are bulky; the testis (fig. 9) being short and thick, and of a tubular form.

The eye (fig. 7) is composed of a round pigment-cup, a lens and cornea; the optic nerve is of some length, and enters from below. The auditory capsule (fig. 8) contains a large, single, spherical otolithe.





A Hancock del W. Wing lith.

C. Muller del C. S. S. lith.

EMBELONIA PULCHRA.

### Fam. 3, Plate 38.

#### EMBLETONIA PULCHRA, ALDER and HANCOCK.

*E. oblonga*, carnea, albo punctata; lobis capitis rotundatis; tentaculis brevibus, distantibus; branchiis ellipticis aurantio-coccineis, albo punctatis; 5—6 utroque dorsi latere, serie unicâ, dispositis.

*Pterochilus pulcher*, Ald. and Hanc., in Ann. Nat. Hist., v. 14, p. 329.

*Hab.* Under stones at low-water mark. Rothesay Bay, Isle of Bute, *J. A.* Saltcoats, Ayrshire, *Rev. D. Lonsborough, junr.*

*Body* about two tenths of an inch long, nearly linear, semitransparent, pale flesh-coloured, minutely spotted with opaque white. *Head lobes* expanding into a kind of veil, indented in front, and produced and rounded at the sides. *Tentacles* linear, rather short and blunt, of the same colour as the body, placed laterally just above the termination of the lobes. *Branchiæ* large, elliptical, with the central vessel bright orange-red, nearly filling the transparent sheaths, which are spotted with opaque white; the red portion is slightly granular, and disposed in indistinct transverse bands. The papillæ are set in a single row of five or six down each side of the back; the first and second pairs are nearly opposite each other, the rest alternate. The gastric vessel may be seen through the transparent skin of a pale orange colour, forming two lateral lines before the heart, and a single one behind it, undulating down the centre of the back, and sending off alternate branches to the papillæ. *Foot* linear, very narrow, transparent, flesh-coloured, truncated in front, and terminating not far behind the branchiæ in a blunt point.

A specimen from Saltcoats, varied a little in colour from the above description; the body being almost colourless, and the papillæ of a chesnut brown.

The only localities we have to record for this handsome and very rare little mollusk are confined to Scotland. We are not able to say whether the *Eolidia minima*, dredged by Professors E. Forbes and Goodsir, in Bressay Sound, Shetland, and communicated by the former to the British Association meeting at Birmingham, in 1839,\* is a distinct species of this genus, or merely a variety of the present. The original sketch by Professor Forbes, liberally placed in our hands, shows the papillæ more slender than in ours, as well as an additional pair, but as the limits of variation in this species are not yet sufficiently known, we shall leave the matter for future decision.

Figs. 1, 2, 3. *Embletonia pulchra*, different views.

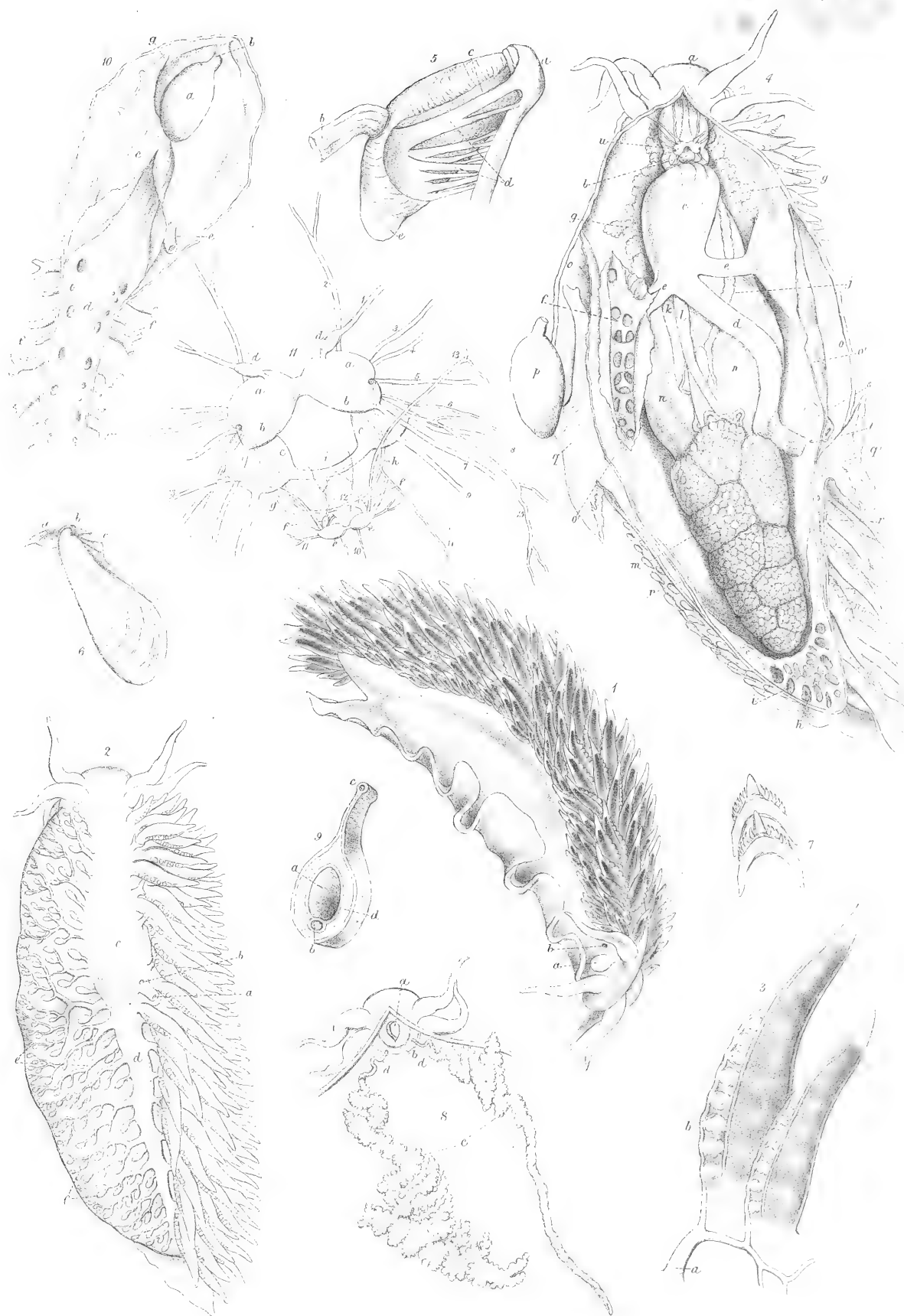
4. Gastric system.
5. Jaws and tongue.
6. Three spines from the tongue.
7. An eye.
8. Ear capsule and otolite.
9. Male generative organ.

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\* See Athenæum for Aug. 31, 1839.







A Hancock del.

Perl & West, Imp.

FIONA NOBILIS.



### Fam. 3, Plate 38 A.

*Figs. 1 and 3.*

#### FIONA NOBILIS, ALDER AND HANCOCK.

*F. alba* vel *flavescens*, lævis; tentaculis longis, acuminate; branchiis numerosis, ad latera dorsi irregulariter dispositis, lineari-conicis, subcompressis, membranâ laterali undatâ, glandulâque centrali brunneâ, apicibus albis opacis splendentibus.

*Oithona nobilis*, Ald. and Hanc., in Ann. Nat. Hist., 2d Ser., v. 8, p. 291.

For. and Hanl., Brit. Moll., v. 3, p. 589.

*Hab.* At low-water mark, Falmouth, *W. P. Cocks, Esq.*

*Body* two inches long, pale buff or whitish, smooth. *Tentacles* long, broad at the base, and tapering to a fine point; not wrinkled or laminated; both pairs nearly equal in length, and very similar in appearance, the anterior pair being placed considerably behind the lip, about half way between it and the dorsal pair. *Branchiæ* very numerous and crowded, commencing behind the tentacles, and set without apparent order on the sides of the back on a sub-pallial expansion, which is a good deal produced posteriorly. They are linear-conical, and rather compressed, particularly towards the base; the lateral membrane is wide and strongly waved; the central gland is of a rich dark brown, the sheath and membrane of a transparent buff colour; the apices are opaque blueish-white, with a brilliant lustre, which is also observable on the back of the animal. *Foot* long and lanceolate, rounded in front, and produced into a fine point behind. The lateral margins are thin and expanded.

Two specimens of this splendid mollusk were found by Mr. Cocks, in August, 1850, near the low-water mark of a spring tide, at Bar Point, Falmouth. "They are beautiful creatures," Mr. Cocks remarks, "but very inactive. When first taken the iridescent appearance of the mantle and tips of the branchiæ was delightful. The tentacula projected like the horns of a bull,—not erect. The branchiæ were carried erect, and the mantle and sides of the foot were fully exposed." Some patches of spawn were found along with these, deposited on the surface of the stone. It was composed of a broad band of ova, forming a single coil, or a coil and a half, and curved inwards at the top, so as to give it a spherical form.

Unfortunately these beautiful animals were killed during the first night after their capture, by having been accidentally placed in a bottle that had contained quinine, and we thus lost the opportunity of seeing them in a living state. The figure represents the appearance of the animal after death.



### Fam. 3, Plate 38 a.

#### GENUS 15. FIONA,\* ALDER AND HANCOCK.

*Corpus* oblongum, limaciforme, subpalliatum. *Caput* terminale, maxillis corneis. *Tentacula* 4 subdorsalia, linearia, non-retractilia. *Branchiæ* papillosæ, elongatæ, membranâ laterali instructæ; ad marginem subpallialem dorsi utrinque dispositæ. *Anus* dorsalis, latus dextrum versus situs. Orificia genitalia disjuncta, infra tentacula dextra posita.

This genus was established by us in the eighth volume of the 'Annals of Natural History,' new series, 1851, under the name of *Oithona*; but unfortunately, as in some other instances, notwithstanding our care to avoid it, we find we had selected a name that was already pre-occupied, having been used by Dr. Baird to designate a genus of *Entomostraca*, in the first volume of the 'Zoologist,' published in 1843. We now, therefore, substitute that of *Fiona*.

The genus has considerable resemblance to *Eolis* in its external appearance, but on a close inspection, many points of difference may be observed between them. The principal are the latero-dorsal anus in *Fiona*, and the presence of a membrane running down the side of each branchial papilla; the latter being much more firmly attached to the back than in *Eolis*. There is likewise, in *Fiona*, a rudimentary cloak; the oral tentacles are placed very far back, and the apertures of the sexual organs are separated. It is with *Hermæa*, however, that *Fiona* would appear to be most closely related, as is evinced not only by the position of the vent, and the two genital orifices, placed far forward; but particularly by the characters of the gastro-hepatic system, the vessels of which are arranged on a similar plan.

The mollusk upon which this genus is founded was discovered by Mr. Cocks, at Falmouth, in 1850, and has not since been met with. It is curious that the only other known species of the genus should be found at the antipodes; the *Eolide à longue queue* (*Eolis longicauda*) of Quoy and Gaimard, a New Zealand mollusk, being evidently a *Fiona*, as is shown by the position of the anus, and the membrane of the dorsal papillæ. Other points of resemblance may also be traced in the tentacles and foot.

The body of *Fiona* is elongated and limaciform, having the sides produced into a sub-pallial expansion, which is most distinct behind. The head is terminal, bearing two pairs of linear, non-retractile tentacles, both sub-dorsal. The mouth is provided with corneous jaws. The branchiæ are papillose and elongated, clothing irregularly the sub-pallial margin along the sides of the back. A produced membranous margin or fringe runs down the

\* A proper name, from Ossian.

## FIONA.

inner side of each papilla. The anus is placed about half way down the back towards the right side. The orifices of the generative organs are separate, placed near together below the tentacles on the right side.

The anatomy of this animal amply proves its generic distinctness. The tissues are very tough and firm when compared with the other *Eolididæ*, particularly the skin and the cellular tissue uniting the viscera. The branchial papillæ, too, are much more firmly attached than usual, and require considerable force to remove them.

The oral orifice is situated on the inferior surface of the head: it is small, and the external lip is divided behind on the median line, much as in *Eolis*. The channel leading to the buccal apparatus is very short and constricted. The buccal mass, (Pl. 38*a*, fig. 4*a*, and fig. 5), is small, rather long, slender, and irregularly elliptical, the corneous plates (fig. 5*c*) being visible at the sides: it is slightly prolonged behind, for the reception of the posterior portion of the tongue, and the muscles are arranged as in *Eolis*.

The tongue is supported on a fleshy ridge that rises up from the floor of the buccal cavity, and extends in the antero-posterior direction from the œsophagus towards the anterior opening. This organ is long, linear, and strap-formed, and is composed of forty transverse semicircular plates of an orange colour, each (fig. 9) bearing a stoutish central spine and six or seven smaller ones at the sides. All the spines are a little bent, and have their points directed backwards towards the œsophageal opening.

The corneous plates (fig. 6) are little short of the size of the buccal mass, and much elongated, well arched and ovate; and, when united and entirely isolated, strongly resemble the valves of a minute *Mytilus*. They are smooth, glossy, and of a brownish amber colour, darkest towards the anterior extremity, which gives support to the cutting blade (*a*). This is a wing-like appendage, of no great size, terminating below in a free point, and having the cutting margin arched forward, plain, and nearly at right angles to the general direction of the plate; above is a small process or fulcrum (*b*), the point at which the two plates are articulated; and immediately behind this point the dorsal margin of the plates is reflected and expanded into an arched lobe (*c*), for muscular attachment.

The œsophagus, (fig. 4, 6), is a short and rather slender tube, which, passing from the upper aspect of the buccal mass towards its posterior extremity, opens into the anterior margin of a distinct pyriform stomach (*c*). This organ has the broad end forward, is placed above the reproductive apparatus, and lies quite in the anterior portion of the visceral cavity. The internal surface does not appear to be lamellated. The intestine (*d*), passes from the posterior extremity of the stomach, and inclining slightly to the right side, passes backwards to the tubular anus, (fig. 2*a*), which is placed a little to the right of the median line of the back, immediately behind the heart. The intestinal tube is rather short, of equal diameter throughout, and internally plicated longitudinally.

The hepatic apparatus is very peculiar in this animal. The pyloric extremity of the stomach receives two biliary ducts (fig. 4 *e e*), one on each side of the intestine. These ducts, or hepatic canals, are nearly as wide as the intestine, and, diverging as they leave the stomach, very shortly pass into the skin at the sides of the back, where each opens into a wide channel (*f*), that extends nearly the whole length of the body. The channels receive numerous branches, which communicate with the glands of the papillæ, and as they approach the lateral expansion at the sides of the body, they appear to be subdivided several times.

## FIONA.

The anterior portions of the great hepatic channels are apparently connected with two folliculated glandular bodies (*g g*), much and irregularly sacculated. These bodies are united to the skin, one on each side, near the region of the stomach; and probably form the inner walls of those portions of the channels. Amidst the cellular tissue at the extremity of the body, behind the ovary, there is likewise a glandular substance, (*l*), of a reddish colour, folliculated and apparently ramified, in connexion with the branches of the hepatic canals within the skin. These branches, at the posterior portion of the body, probably form a sort of network of tubes across the dorsal aspect. Such, perhaps, may be inferred from the appearance they present (*l*), when the skin of the back is divided down the median line.

The arrangement of the hepatic canals differs from that which prevails in the *Eolididæ*. In *Eolis*, *Embletonia*, *Doto*, *Dendronotus*, *Lomanotus*, and *Antiope*, the principal canals lie free in the visceral cavity, and in all of them there is a median posterior trunk. In this genus there is no such trunk; and the canals are almost entirely within the skin. In this respect *Fiona* resembles *Hermæa*, in which the whole of the hepatic ramifications are apparently connected with the skin, and there are only two principal trunks, which pass down the sides of the back. It is evident, however, that the digestive system alone sufficiently distinguishes *Fiona* from all the above genera, not excepting *Hermæa*.

The hepatic glands are large, nearly filling the papillæ: they are slightly and irregularly sacculated, with the inner surface of the investing membrane lined with a dark granular substance; above, this substance is very abundant, forming a dense mass; below, the membrane in some of the papillæ is entirely devoid of it. We have failed to detect any ovate vesicle like that of *Eolis* in the apex of the papillæ, neither have we been able to determine whether or not the apex is perforated.

There are two large, much folliculated glands (fig. 8 *c*), lying beneath the stomach and extending almost half way down the body. These terminate in front each in a slender duct, (*d, d*), which sinks into the fleshy frontal margin of the foot. At first sight, these organs have the appearance of being connected with the digestive system, and we originally looked upon them as salivary glands; but further experience induces us to believe that they are for the purpose of secreting mucus, which probably passes out in front of the foot, lubricating the surface over which the animal is moving.\*

The reproductive organs are placed further forward than usual, and have two external orifices (fig. 1 *a, b*), one placed a little in advance of the other, on the right side of the head, between and a little below the tentacles. The one in front is for the exertion of the untromittent organ, the other is rather small and is common to both the female and androgynous apparatus. On laying open the dorsal skin, the reproductive organs are found, as usual, to occupy much of the visceral cavity, having the stomach and intestine lying above, and the buccal mass in front. They are formed on the type of those of *Eolis*. The mucus-gland (fig. 4, *n, n*), is exactly of the same form, and the mode of union of the androgynous parts with the oviduct and testis is the same as in that genus. The only modification of any interest is in connexion with the testis (*l*). We know of no other species in the whole of the *Eolididæ*, in which it is furnished with a distinct vas deferens. In this respect *Fiona*

\* The so-named salivary glands of *Doto fragilis* may perhaps prove to be merely mucus-glands of a similar nature.

## FIONA.

resembles some of the *Dorides*, particularly *Doris repanda*, in which the testis has appended to it, not only a vas deferens, but is likewise supplied with a much constricted duct, which unites it to the oviduct as in *Fiona*; and the testis, too, of the *Doris* is very similar to the same organ in this animal.

The vascular system is very interesting, inasmuch as we have been able to trace the branchio-cardiac vessels more completely than in any other member of the family. Indeed nearly the whole of these vessels are distinctly visible on the skin of the back, rising above the general surface, and exhibiting a very curious and novel spectacle, much resembling the vascular appearance on the lateral expansions of *Elysia*. The heart (fig. 2 *a*, and fig. 10) is situated about the middle of the back, where it forms a large oval swelling immediately below the skin, having the generative organs beneath. From the posterior extremity of the swelling, an elevated, broad, and rounded ridge, (fig. 2 *d*), passes down the median line of the back to the termination of the body. This ridge is joined on either side by numerous similarly elevated branches, (*e*), which divide and subdivide as they approach the cloak-like expansion on the sides of the body. The whole of these branches, and their subdivisions, standing boldly up from the general surface of the skin, have the branchial papillæ set along them, and they give off twigs, which pass up the broad membranous expansion of the papillæ, (fig. 3).

On opening the heart from above, the ventricle (fig. 10 *a*) and auricle (*c*) are found to occupy a well-defined oval pericardium. The ventricle is large and muscular, of an irregular elliptical form, giving off the aorta (*b*) in front, which, in the usual manner, supplies branches to the various organs. The auricle is united to it behind, a little on the left side; it is delicate in comparison with the ventricle, but is nevertheless abundantly supplied with muscular fibres; it lies diagonally in the pericardium, having the left side advanced almost to the front of that organ, where it receives a trunk-vein (*g*) from the skin. The right side of the auricle stretches backward, and receives a similar trunk-vein from the skin of this side, almost at the posterior extremity of the pericardium. On laying the dorsal wall of the auricle open, its cavity is found to be continuous with that of the great posterior elevated median ridge or trunk-vein (*d*) before alluded to; and on opening this, the various lateral branches (*ff*) are observed debouching into it on either side. It is therefore evident that these three trunk-veins, their beautiful system of ramifications all lying imbedded in the skin, are branchio-cardiac veins, and herein we find a clear proof also of the branchial character of the papillæ.

The papillæ (fig. 3) are, as we are already aware, of a very peculiar character in this animal, being somewhat compressed, as in *Eolis papillosa*, and having a distinct, broad, frilled membrane (*b*) extending up their inner margin. It is, as before remarked, from the border of this membrane that the twigs of the efferent vessels are given, and they pass down its entire length. When a transverse section of a papilla (fig. 9) is made, a widish canal (*b*) is seen to pass up the opposite margin. This may be looked upon as an afferent branchial vein, and deteriorated blood, passing from the skin up this canal, may be supposed to filter through the cellular tissue (*d*), between the external skin and the glandular sheath of the papilla, and so find its way to the efferent vessel (*c*) at the free border of the membrane. If this view be correct, and it would seem scarcely possible to doubt it, the papillæ are evidently specialised breathing organs, and by no means so low in organisation as has been thought.

At the same time, from the arrangement of the branchio-cardiac, or efferent vessels, and

## FIONA.

from their elevation above the general surface of the skin, thus exposing to the influence of the surrounding medium nearly three fourths of their circumference, it is pretty clear that the dorsal skin itself must act, to some extent, as a gill, especially when we consider further, that the whole of the blood returned to the heart does not pass through the papillæ: much of it, no doubt, circulating in the spongy tissue of the skin, passes at once into the efferent vessels: and, indeed, small orifices for this purpose are seen in the wall of the great median trunk-vein. Here, then, as in *Doris*, the blood is partly aerated in specialised breathing organs and partly in the skin.

In connexion with the vascular system, *Fiona* is provided with an additional propelling organ similar to what, in *Doris*, we have called a portal heart. As in that genus, this propelling organ (fig. 10 *e*) lies below the floor of the pericardium, and, in like manner, opens into that organ. In this species it is considerably elongated, with the ends rounded, and is placed far back on the right side of the pericardium. It is firmly attached to the skin of the body, and is internally longitudinally plicated. Judging from our knowledge of this heart in the *Dorides*, it may be supposed to throw venous blood from the pericardial cavity to the glands of the papillæ. In *Fiona*, it is certainly connected with the skin, and probably has some relationship to the vascular apparatus therein.

A renal organ also probably exists, though we have failed to detect it. A small distinct orifice (fig. 2 *b*), however, opens externally immediately above the anus, and close to the posterior border of the heart. There can be little doubt that this is of the same nature as the minute opening by the side of the anus in *Doris*, and which, in that genus, leads into an extensive renal apparatus.\*

The cerebral ganglia of the nervous system resemble those of *Doris*, rather than of *Eolis*. They are placed at the commencement of the gullet: there are, as usual, three pairs of principal œsophageal ganglia, though, at first sight, only two are apparent,—the cerebroid (fig. 11, *a, a*), and branchial (*b*) being completely fused, forming two oval masses, resting upon the upper surface of the gullet, one on each side of the median line, across which they are united at the anterior extremity by a short but distinct commissure: their posterior extremities diverge, and are slightly bilobed, marking the boundaries of the two ganglia of which each mass is composed,—the anterior lobe indicating the cerebroid, the posterior the branchial. The pedial ganglia (*c, c*), are irregularly rounded, being equal in bulk to the cerebroid and branchial together. They lie against the sides of the gullet, and are united to the under surface of the central masses. Besides these there is a pair of accessory ganglia,—the olfactory (*d, d*).

The buccal ganglia, (*e, e*), are placed in the usual situation on the buccal mass below the gullet. These are scarcely larger than the olfactory, and are of an oval form, with their inner extremities connected across the median line by a short commissure; their outer extremities receive a cord (*g*), of communication from each of the cerebroid ganglia. Two minute elliptical, gastro-œsophageal ganglia (*f, f*), are almost sessile on the anterior border of the buccal. Thus, in all, there are six pairs of ganglia; four above the gullet—the œsophageal; and two below it—the buccal.

\* Since the publication of our anatomy of *Eolis*, we have detected a portal heart and renal orifice in that genus.

## FIONA.

The nerves are distributed much as in *Eolis*, and as in that genus there are two large ones (13), which issue from the buccal mass, and are probably connected at their origin with ganglia, which must be looked upon as belonging to the sympathetic system. Immediately on emerging from the buccal mass, they are connected to the buccal ganglia at their point of union with the gastro-æsoophageal, and then arching upwards, go to supply the glands of the papillæ.

There is also a single nerve (14) given off from the delicate collar, the ends of which are united to the under surface of the branchial ganglia. This is a visceral nerve, and similar to that in *Eolis*. Another nerve (15), apparently supplying the genitalia, has been observed; this seems to come from the right branchial ganglion at its union with the pedial. These two nerves, which, however, require further examination, probably represent those that come from the visceral ganglion in *Doris*; and which, in that genus, are distributed to the sympathetic ganglia of the digestive, reproductive, respiratory, and circulatory organs.

### EXPLANATION OF THE PLATE.

Fig. 1. Side view of *Fiona nobilis*:—*a* penis, partially exerted; *b*, orifice leading to the female and androgynous parts.

2. Dorsal view of the same, the papillæ of one side being removed:—*a*, anal nipple; *b*, renal orifice; *c*, heart; *d*, great posterior branchio-cardiac vessel, raised above the general surface; *e*, small branches, likewise raised above the surface, leading from the papillæ to the same; *f*, scars formed by removing the papillæ.
3. Two of the papillæ enlarged:—*a*, small raised vessel leading from the papillæ to the great branchio-cardiac trunk; *b*, puckered membranous fringe with the efferent vessel running down its margin.
4. General view of the viscera, seen from above:—*a*, buccal organ; *b*, æsophagus; *c*, stomach; *d*, intestine; *e,e*, hepatic-ducts, leading from the great lateral hepatic channels within the skin; *f*, one of these channels laid open, exhibiting the canals from the papillæ opening into the same; *g,g*, folliculated glandular bodies in connexion with the anterior portions of the great hepatic channels; *h*, gland-like substance in connexion with the hepatic channels; *i*, some of these channels laid open; *j*, a portion of the right mucus-gland; *k*, penis; *l*, testis; *m*, ovary; *n,n*, mucus-gland in connexion with the female channel; *o,o*, pericardial cavity, seen in section; *o',o'*, floor of the same; *p*, ventricle; *q*, auricle; *q'*, portion of the same attached to the great posterior branchio-cardiac trunk-vessel; *r,r*, the same vessels longitudinally divided; *s*, portal heart, opening through the floor of the pericardium; *t*, renal orifice; *u*, cerebral ganglions.
5. Side view of buccal organ:—*a*, anterior extremity; *b*, æsophagus; *c*, horny jaw; *d*, muscles for advancing the buccal organ; *e*, lingual sheath.
6. Inner view of one of the jaws:—*a*, cutting edge; *b*, point of articulation; *c*, expanded process at the dorsal margin for muscular attachment.
7. Two of the lingual plates.
8. View of two glandular organs lying beneath the stomach, supposed for the purpose of lubricating the foot:—*a*, oral opening; *b*, thickened anterior margin of the foot; *c,c*, glandular organs; *d,d*, their duct.



## FIONA.

9. Transverse section of a branchial papilla :—*a*, gland ; *b*, afferent vessels ; *c*, efferent vessel, leading from the papilla to the great branchio-cardiac trunk ; *d*, intercellular space, between the outer wall of the papilla and the sheath of the gland.
10. Dorsal view of the heart, the pericardium being laid open :—*a*, ventricle ; *b*, aorta ; *c*, auricle ; *d*, great posterior branchio-cardiac vessel laid open, showing its connexion with the auricle, and likewise with the branches from the papillæ ; *e*, portal heart, lying under the floor of the pericardium, and opening through it ; *f, f*, efferent vessels from the branchial papillæ ; *g*, lateral branchio-cardiac trunk-vein.
11. Cerebral ganglions :—*a, a*, cerebroid ganglions ; *b, b*, branchial ; *c, c*, pedial ; *d, d*, olfactory ; *e, e*, buccal ; *f, f*, gastro-œsophageal ; *g*, nervous cord, uniting the buccal ganglions to the cerebroids ; *h*, small collar connecting the branchial ganglions ; *i*, great œsophageal or pedial collar ; 1, olfactory nerves ; 2, nerves to the upper portion of the channel of the mouth ; 3, 4, those to the sides of the channel of the mouth and the lips ; 5, those to the skin at the sides of the head ; 6, 7, pallial or dorsal-skin nerves ; 8, 9, pedial nerves ; 10, lingual nerves ; 11, buccal nerves ; 12, œsophageal nerves ; 13, hepatic nerves, going to the glands of the papillæ ; 14, visceral nerves ; 15, a nerve probably supplying the male intromittent organ.



## GENUS 16. HERMÆA, LOVÉN.

*Corpus* elongatum, postice attenuatum, non palliatum. *Caput* terminale. *Tentacula* 2, auriformia, extus canaliculata. *Maxillæ* nullæ. *Branchiæ* elongatæ, papillosæ, ad latera dorsi dispositæ. *Anus* anticus in medio dorsi situs. *Orificium generationis* laterale pone tentaculum dextrum.

The interesting little mollusks on which this genus is founded, are distinguished from their allies by the peculiar form of their tentacles, which are ear-shaped, reminding us, in this respect, of *Elysia* and *Aplysia* among the naked mollusks, and of the family of *Pyramidellidæ* among the testaceous tribes. With the last-mentioned genus, the relationship can only be considered one of analogy; their affinity with the first may be further traced in the numerous branchings, in close connexion with the skin, of the hepatic organ, and in the bilateral disposition of the principal trunks; the great central canal having disappeared. And, indeed, in this latter respect, all the members of the *Pellibranchiata*, an order recently proposed by us, agree with this genus: and some of them so nearly resemble *Hermæa dendritica* in general form, that, were its branchial papillæ removed, it might be placed along with them. The genus was established by Professor Lovén in the Proceedings of the Royal Swedish Academy for 1844. Its nearest ally is the *Stiliger* of Ehrenberg, from which it differs in the form of the tentacles; these organs in *Stiliger* being long, linear, and tapering. The *Calliopæa* of D'Orbigny is another allied genus, if, indeed, it is not synonymous with the last, which we strongly suspect to be the case; but as the position of the anus, a material point in the division of the genera, is left unnoticed by M. D'Orbigny, in his description of *Calliopæa*, and as he considers the tentacles to be oral, no correct conclusion can be come to, until the species he founded it upon shall have been re-examined.

Not more than two or three species of *Hermæa* have been noticed, and these are confined to the European seas, having hitherto been found only in the British Islands and in Norway. They live in shallow water, are gregarious in their habits, and appear to be vegetable feeders, though probably not exclusively so, as M. Lovén has found *H. bifida* on *Tubulariæ*. Their motions are quick and lively, and their power of extension and contraction remarkably great.

The body of *Hermæa* is generally slender, and either linear or ovate-oblong, terminating posteriorly in a slender pointed tail. There is no cloak, but sometimes the sides of the body are a little produced, and overhang the margins of the foot. The head is terminal, and occasionally slightly marginated in front, giving it a subvelar aspect. The mouth is inferior, and not provided with corneous jaws: the tongue is slender and denticulated. The tentacles are two in number, placed dorsally, and longitudinally folded or ear-shaped. The branchiæ are oblong or ovate papillæ clothing the sides of the back. The anus is dorsal, placed far forward on the median line and in front of the heart: it is usually tubular. The aperture of the genital organs is placed below and a little behind the right tentacle. The foot is narrow and linear.

## HERMÆA.

Each of the British species would appear to constitute a distinct section.

Sect. 1. Tentacles with both margins terminating at the side of the head: body cylindrical.

*H. bifida*.

Sect. 2. Tentacles with the anterior margin continuous with the sides of the head, forming a sub-veil: body with the sides depressed and slightly expanded. *H. dendritica*.

Little is known of the anatomy of this genus farther than is revealed through the transparency of the skin; and though we have had *H. dendritica* in considerable abundance, it has never been in a fit state for dissection. The compressor, however, has shown us the buccal organ (Pl. 43, fig. 14) and its dental apparatus. The former is broadly oval, and unprovided with corneous jaws. The tongue (*e*) is long and narrow, and is furnished with a single row of articulated plates, each bearing a broad tooth or process. The plates (fig. 15) are much shorter than those of *Alderia*, and the teeth gradually diminish in size towards the anterior extremity, which is very finely pointed and sometimes spirally coiled. This peculiar tapering form of the tongue we have observed only in this genus; and it no doubt arises from the fact, that the early or first-formed plates are not shed in this as they are in all the other nudibranchs.

The gastric system is peculiar in *Hermæa*. In this genus there is apparently no posterior central vessel or hepatic canal, as in the other *Eolididæ*; but the anterior lateral ones are excessively developed. These in *Eolis* most commonly assume the form of simple branches inclined forwards, but in *Proctonotus* and *Antiopa*, each is made up of two portions, one of which curves forwards, the other backwards. The gastric or hepatic vessels in *Hermæa* seem to form two continuous lines, one on each of the back, only broken a little near the region of the heart. This break indicates their point of union with the upper surface of the stomach, and that each is composed of two branches, as in *Antiopa*. One of these branches, as in that genus, passes forwards, and is connected with the glands of the anterior papillæ; the other, passing backwards, is of great length, and terminates in a free attenuated point in the tail; this branch is connected with the posterior papillæ. The whole of these trunk-branches or vessels give off smaller branches, which ramify in various directions; particularly in *H. dendritica*, in which those on the side of the body assume a regular dendritic character. It is with these lateral ramuscles that the papillæ are connected. All the trunk-vessels and branches are granulated and coloured like the terminal glands, and lie immediately below the skin, and in connexion with it.

The hepatic gland (fig. 16) within the papillæ is much branched, and in *H. bifida* is a beautiful structure, exhibiting another of those simple and instructive modifications of glandular mechanism, so frequently observed in this tribe of animals. The central vessel or duct is linear and slender, and gives origin to numerous subdivided branches, arranged in whorls. The lower portion of the central duct is simple; and just within the base of the papillæ it is encircled with a narrow, almost transparent, belt (*b*): at this point the duct is occasionally contracted (*c*), as if by a powerful sphincter, cutting off all communication between the gland and the gastric or hepatic vessel. The action of this sphincter may be distinctly observed, by the aid of a good pocket lens, when the animal is free and moving about; when first one papilla and then another may be seen thus shut off, and after a while

## HERMÆA.

again gradually regaining its former state. The true signification of this occasional isolation of the gland seems pretty obvious. The alimentary matters, we know, pass pretty freely into the principal vessels of the gastric system, and might, by any irregular action, be forced into the minute and intricate structure of the gland, were it not for such an apparatus as that just noticed, which is probably brought into action by the irritating influence of misdirected currents within the gastric vessels.

The stomach is placed far forward; and the intestine, which is very short, terminates in a rather long tubular anus close in front of the heart. This latter organ is placed in a considerable oval swelling on the mesial line of the back, and immediately behind the position of the stomach.

The eyes are well developed. In *H. dendritica* vibratile cilia were detected only in front of the head, but probably they exist elsewhere. The reproductive organs have not been examined. The larva (Pl. 40, fig. 7) in *H. dendritica* resembles that of *Eolis coronata*, but perhaps still more closely that of *Limapontia*, as evinced by the minuteness of the ciliated oral lobes.







A. Hancock del. W. Wieg lith.

C. Holmard del. T. Zentgraf lith.

HERMÆA BIFIDA



### Fam. 3, Plate 39.

#### HERMÆA BIFIDA, MONTAGU, sp.

*H. gracillima*, posticè attenuata, pellucida, alba, duobus lineis rubris signata; branchiis ovato-linearibus, inæqualibus, roseo-tinctis, pellucidis, vase centrali rubro, ramoso; seriebus indistinctis utroque dorsi latere digestis; tentaculis involutis, truncatis; lateribus anterioribus pedis rotundatis.

*Doris bifida*, Mont., in Linn. Trans., v. 12, p. 198, pl. 14, f. 3.

*Tritonia bifida*, Flem., Brit. Anim., p. 284.

Thomp., in Ann. Nat. Hist., v. 7, p. 480.

*Hermæa bifida*, Lovén, in Ofv. Kon. Vetén. Akad., 1844, p. 50. Index Moll. Scand., p. 7.

*Hab.* Among sea-weeds and zoophytes near low-water mark, and in shallow water. Devonshire, *Montagu*. Belfast Bay, *Mr. Getty* and *Mr. Hyndman*. Black Rock, Leith, *Rev. D. Landsborough, junr.*

*Body* nearly an inch in length when extended, but capable of great contraction, linear, very slender, pellucid, and of a pale yellowish colour. *Tentacles* rather short, truncated, and longitudinally folded or involuted; open down the exterior side, and produced above into two unequal points; the anterior one short, the posterior long, and generally curved a little forwards. These points, and the opening down the side, give the tentacles the appearance of being bifid. The tentacles are red before and behind, and yellowish-green at the sides. *Head* small, a little arched in front, and slightly produced at the sides. The upper part of the head, and between the tentacles, is lake-red, behind these there is a pale area in which the eyes are placed, succeeded by a central red blotch on the back; and two dark red lines, formed by the gastric vessels, run down the sides of the back nearly to the tail. These are slightly branched; the principal branches running into the papillæ. The ridge of the back and the sides below the papillæ are minutely freckled with lake-red. *Branchiæ* numerous and very unequal in size, some of them being long, and others extremely short. They are linear-ovate, pointed at the top, and a little tuberculated on the sides towards the upper part; but in this they are very irregular, the outline varying much according as they are expanded or contracted. They are very transparent, and nearly colourless, having only a tinge of rose-colour over the surface. The central vessel, which is lake-red, is very slender, and extends the whole length of the papilla, sending off verticellated branches, which are subdivided at their extremities, giving the papillæ an elegant dendritic appearance. The papillæ nearly meet on the back a short way behind the tentacles, and are set down the sides in ten or twelve indistinct transverse rows, containing two or three papillæ each. *Foot* linear, very narrow, nearly colourless below, and freckled with red at the sides; between it and the head there is a streak of grass-green. In front it is a little expanded, and slightly belobed. The tail is very slender and extensile, being occasionally produced a great way beyond the

## HERMÆA BIFIDA.

branchiæ. The heart forms a swelling on the anterior part of the back, in front of which the tubular vent is situated.

This lovely nudibranch was long known only from the description of Montagu. More recently it has been again brought to light by the indefatigable naturalists of Belfast; but during our researches on various parts of the coast, continued for several successive years, it has never been our good fortune to meet with it. We had almost despaired of getting a drawing from a living specimen, when our friend Mr. David Landsborough, Jun., fortunately met with it near Edinburgh, and kindly sent us from thence the splendid specimen from which our figures and description have been taken. This specimen was more than three times the size of that described by Montagu, and appears in every respect to have been in a much finer state of development. It was obtained along with two or three other individuals of different sizes on a plant of *Griffithsia setacea*, gathered on the Black Rocks, Leith.

Professor Lovén, who has published an excellent description of this species in the 'Proceedings of the Royal Swedish Academy,' informs us, that it is gregarious in shallow water, especially on *Tubulariæ*. He remarks, that when touched, it discharges a fetid colourless liquid, with the odour of *Geranium Robertianum*, a circumstance we did not observe in our specimen.

Not one of the least attractions of *Hermæa bifida* is its crystalline transparency, which adds much to the delicacy of its appearance. It is a very active animal, and when in progression, expands and contracts itself with great rapidity. Its partiality to swimming on the surface has been noticed by most of those who have met with it.

Our specimen was received in October, and in the course of a day or two a single mass of spawn was deposited in the vessel where it was kept, but not being fixed to any substance, we cannot speak with certainty of its normal form. It was cylindrical and twisted in an irregular manner, with the ova large, white, and arranged in transverse lines.

Figs. 1, 2, 3. *Hermæa bifida*, various views.

4. Two of the papillæ much magnified.
5. The tentacles highly magnified.
6. Spawn.
7. A portion of the spawn more highly magnified.





### Fam. 3, Plate 40.

#### HERMÆA DENDRITICA, ALDER and HANCOCK.

*H. ovato-oblonga*, posticè attenuata, virescenti-alba, lineis viridibus dendriticis ornata : branchiis elliptico-linearibus, viridibus, in seriebus 8 digestis : tentaculis validis, auriformibus : lateribus anterioribus pedis subangulato-rotundatis.

*Calliopea dendritica*, Ald. and Hanc., in Ann. Nat. Hist., v. 12, p. 233.

*Hgb.* On *Codium tomentosum*, near low-water mark, Torbay.

*Body* three tenths of an inch long, greenish white, with dendritical green markings. It is rather narrow behind the head, expanding towards the centre of the back and tapering to a slender point at the tail, but all the parts are capable of great elongation and contraction, and are sometimes very much attenuated. The sides of the body are depressed, and generally overhang the foot. *Head* rounded in front, with a sub-velar margin curved inwards in the centre towards the mouth. *Tentacles* rather large, auriform, arising from the sides of the head, and folded longitudinally ; they are somewhat dilated at the base, and slightly tapering and rounded at the apex, towards which there are a few opake white spots : a line of green runs up the back of each, which is branched at the sides. These lines unite with two principal dorsal lines, which pass along the sides of the back, and terminate near the tail ; in front, the latter divide into many branches over the head, and in their course backwards give off lateral branches proceeding to the branchiæ, and covering the sides with beautiful and delicate ramifications. Other branches pass in various directions from the main trunks ; the whole exhibiting a granular structure. *Branchiæ* long, and nearly linear when fully extended, tapering gradually at the top, elliptic oblong when contracted ; the central vessel green and lobated, giving them a transversely banded appearance : the outer sheath transparent, and sprinkled over with opake white spots. The papillæ are set in eight transverse rows, of three or four each. *Foot* transparent white, tinged with green, rounded in front, slightly produced and obtuse at the sides. It is rather broad, with nearly parallel sides, but much attenuated posteriorly to the tail, which is often held in a curved position, and is frequently much elongated. Dendritical markings are seen through the skin in the posterior part. *Anus* forming a rather stout, conspicuous tube on the back, before the heart, and not far from the commencement of the branchiæ. The eyes are large, and situated a little behind the tentacles.

The heart pulsates ninety-six times in a minute.

Nearly a hundred specimens of this beautiful and curious little creature were sent to us by Mrs. Wyatt, from Torquay, in the summer of 1843, having been found by her on an insulated piece of rock left bare at low tides in Torbay, feeding upon *Codium tomentosum*. Unfortunately all the specimens were dead when they reached us, and the whole of the

#### HERMÆA DENDRITICA.

characters were not sufficiently made out. On our visiting Torquay, however, in May 1845, Mrs. Wyatt procured for us a supply of the *Codium* from the same spot, and on a careful examination of the sea-weed, we were so fortunate as to find two fine living examples of the supposed *Calliopæa*, which we then ascertained, from the peculiar form of the tentacles, to belong to the genus *Hermæa* of Lovén.

This species is very lively in its motions, and, like most of the vegetable feeders of the tribe, it is gregarious, as the large number collected by Mrs. Wyatt sufficiently shows. Its breeding season appears to be in May and June. The spawn is contained in a thick, transparent, gelatinous belt, slightly depressed, and nearly twice coiled, attached to sea-weed, frequently in clustered masses. The eggs are numerous, with a slight tendency to a transverse linear arrangement.

One of the two individuals last obtained, both of which lived with us for some time, spawned on the 13th of May, and on the 22d the ova were entirely hatched. The larva does not differ materially from that of the other *Eolididæ*. It is, however, more transparent than usual, and occupies nearly the whole of the shell, which is furnished with an operculum. The cilia of the general surface are large and conspicuous.

This beautiful species varies considerably in intensity of colour, some having the papillæ and dendritic markings of a very dark green, while in others they are comparatively pale, and occasionally of an olive green, with the bands of the papillæ of a yellowish olive. In some the markings are not so fully developed as in others.

- Figs. 1, 2, 3. *Hermæa dendritica* in different positions.  
4. Two of the papillæ, more highly magnified.  
5. Spawn.  
6. A portion of the same, showing the ova.  
7. Larva.

GENUS 17. ALDERIA,\* ALLMAN.

*Corpus* ovato-oblongum, sub-convexum, non palliatum. *Caput* terminale, distinctum, utrinque in lobum lateralem productum. *Tentacula* nulla. *Maxillæ* nullæ. *Branchiæ* papillose, utroque lateri dorsi dispositæ. *Anus* posticus, in lineâ mediâ dorsi situs. Orificium genitale anticum ad latus dextrum.

This genus was first described by Professor Allman, in a paper read at the York meeting of the British Association in 1844, and was afterwards published, with a more detailed description, by the same excellent naturalist, in the 'Annals of Natural History' for January, 1846. The single species on which it is founded had been previously observed by Professor Lovén of Stockholm, who had placed it in the *Stiliger* of Ehrenberg. M. Lovén has since adopted the genus *Alderia* in his 'Index Molluscorum Scandinaviæ.' This genus has obvious relationship with *Hermæa* and *Stiliger*, from both of which it differs, as well as from the other genera of the order, in the total absence of tentacles. It is also distinguished from the two genera above named, by the more expanded form of the foot, as well as by the position of the anus, which is not placed forward on the back, as in these genera, but occupies a posterior position, similar to that of *Proctonotus* and *Antiopa*. In the absence of tentacles, and in the broad reflected sides of the foot, it shows an approach to the Bulla tribe, and likewise to a small Inferobranchiate Mollusk, described by us in the Eighteenth Volume of the 'Annals of Natural History,' and referred, perhaps erroneously, to *Pelta* of Quatrefages. It appears to us to be also, in some measure, related to *Limapontia*, which is not only deficient in tentacles, but has the buccal apparatus and tongue similar to those of *Alderia*; and the curious crystalline, spur-like stiletto, in connexion with the reproductive organs, is found in both. Professor Lovén remarks of this animal, that it has the branchiæ of *Eolis*, the vent of *Doris*, and the head and foot of *Akera*.

The absence of corneous jaws, as well as the circumstance of its having been found on Ulvæ, leave little doubt that *Alderia* is a vegetable feeder, and this view is confirmed by its gregarious habits. The genus is more nearly amphibious than any other of the tribe, living in salt-marshes or estuaries with a muddy bottom, and only partially overflowed by the tide.

The body is ovate oblong, rather broad, and not much depressed. The head is terminal and distinct, narrower than the body, and produced into short lobes at the sides. The mouth is without jaws, and has a narrow spinous tongue. There are no tentacles. The eyes are distinct, and placed rather laterally on the narrow posterior part of the head. The branchiæ, which are papillose or styliform, are arranged in transverse rows on the sides of the back: there are few in front, but they become larger and more numerous behind. The anus is nipple-shaped, and is placed posteriorly on the median line of the back. The foot is

\* Named after one of the authors of this work.

## ALDERIA.

large, rounded in front, and expanded and reflected upwards at the sides. The orifice of the genital organs is situated very far forward on the right side below the head.

Professor Allman, in the paper already alluded to, has given some account of the anatomy of this genus, partly founded upon our own observations; and, from the difficulty of procuring specimens in a fresh state, we have not been able to add much to the original stock of information on this interesting part of the subject.

The buccal organ (Pl. 43, fig. 17) is of an irregular oval form, and unprovided with corneous jaws. The tongue (fig. 17 *c*, and fig. 18) is narrow, being composed of a single row of long arched plates, (sixteen or seventeen in *A. modesta*,) each supporting a broad scoop-like tooth or process, which, together with the peculiar form of the plate and the mode of articulation, gives the whole very much the appearance of a minute vertebral column. This tongue is crystalline and resists acids. At the front of the tongue we have observed a few additional teeth; these may perhaps be of the nature of the spinous prehensile collar found in some of the Dorides, as well as in *Limapontia* and many other mollusks.

The stomach is placed rather far back in the body, and from the upper surface gives off folliculated branches, which penetrate the base of the anterior branchial papillæ. From below other folliculated branches, connected with the gastric organ, go to the posterior papillæ. The glands of the papillæ are large, and appear to be highly organised. Further than this, we have not been able to examine the digestive system, which, on the whole, was only obscurely observed.

We know little of the genitalia, excepting that the apex of the intromittent organ is furnished with a perforated crystalline stiletto (fig. 19*a*), curved backwards, and very closely resembling a similar spur-like organ in *Limapontia nigra*. Hence, perhaps, may be inferred, that the reproductive apparatus is arranged on the type observed in that species.



GENUS 18. PROCTONOTUS,\* ALDER and HANCOCK.

*Corpus* ovato-oblongum, depressum, postice acuminatum. *Caput* subinferius, velo parvo, semilunari, obtectum. *Maxillæ* corneæ. *Tentacula* 4, quorum 2 majora, linearia, dorsalia, et 2 minora, ad marginem veli disposita. *Branchiæ* papillosæ, elongatæ vel ovatæ, ad marginem lateralem prominentem dorsi ordinatæ, et anteriùs circum caput collocatæ. *Anus* posticus, in lineâ mediâ dorsi situs. Apertura genitale ad latus dextrum.

On introducing this genus to the notice of naturalists in the 'Annals of Natural History' for March, 1844, we proposed for it the name of *Venilia*; but becoming aware soon afterwards that the name had, a short time previously, been appropriated in Morton's 'Synopsis of the Chalk Fossils of the United States,' to a genus of bivalves, we substituted for it the present appellation; announcing the alteration in the following May number of the same journal.

This genus unites some of the characters of the *Dorididæ* with those of the *Eolididæ*, showing an approach to the former family in the broad and subdepressed form of the body, the rudimentary cloak, and the position of the vent. Its relationship with *Triopa*, in that family, is evinced not only by the general form of the body, but likewise by the shape of the head, by the position of the oral tentacles, and by the marginal processes, the situation of which in *Triopa* resembles not a little that of the branchial papillæ of Proctonotus. The true place of this genus, however, is in the *Eolididæ*, where it forms the centre of a small group of genera, mostly of recent discovery, in which the dorsal anus, and other characters indicating a departure from the Eolidian type, are more or less developed.

The *Zephyrina* of Quatrefages has been supposed to be synonymous with this genus; but it appears to differ in having four linear tentacles visible from above as in *Eolis*; and as M. de Quatrefages is uncertain with respect to the position of the anus, the true place of *Zephyrina* can scarcely be fixed with certainty until some further information concerning it is obtained.

The body of *Proctonotus* is ovate-oblong, subdepressed, and tapering to a point behind. There is no distinct cloak; but there is a projecting margin on the sides of the back, making an approach to the pallial form. The head is inferior, and covered with a small semicircular veil; from its sides proceed two short oral tentacles. There are two dorsal tentacles placed in the usual position. They are linear and non-retractile. The mouth is furnished with a pair of strong corneous jaws, and a rather broad, denticulated tongue. The branchiæ are large, papillary, and ovate; having an extremely small central gland, reaching scarcely half the length of the papilla. They are arranged down the produced sides of the back and round the head in front. The anus is tubular, and situated in the median line of the back, near the posterior termination of the branchiæ, behind which the body tapers to the tail. The foot is rather broad, expanded at the edges, and produced posteriorly. The aperture of the genital organs is placed a little in advance of the centre of the body on the right side.

\* From *προκτός*, anus, and *νώτος*, dorsum.

## PROCTONOTUS.

The only species procured was dredged in the laminarian zone. There can be little doubt that in habit it is carnivorous.

Having had only a single perfect individual of *Proctonotus* for examination, the following account of its anatomy is necessarily very imperfect; enough, however, has been determined to prove its close relationship to *Antiopa*.

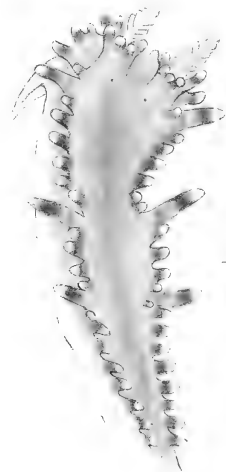
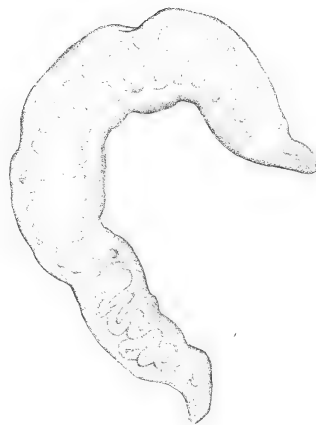
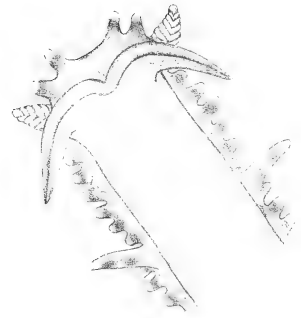
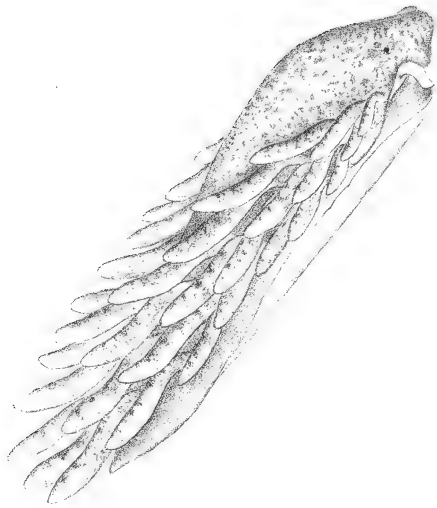
The corneous jaws (Pl. 43, fig. 11) are largely developed; they are flattened, triangular, and placed nearly horizontally immediately behind the oral opening; each consists of two parallel plates (*a*, *b*) united down the sides and open behind. At the anterior angle is a third plate (*c*), much smaller than the others, forming a kind of cap over that angle, the posterior edge standing out considerably from the under surface. On the upper surface, near the anterior extremity, the jaws are bound together by a corneous strap (*d*), which forms an arch across the median line. This strap probably acts as a spring to assist in keeping the jaws asunder when the muscles are relaxed. Judging from the analogy that the jaws bear to those of *Antiopa*, there can be little doubt that the cutting edges are in connexion with the anterior cap-plates. The general form of the jaws is the same in both genera; and were the spaces between the two parallel plates of each jaw in *Proctonotus* filled up, the resemblance would be nearly perfect. The tongue is broadish, and formed as in the *Dorides*; the spines (fig. 12) are arranged in numerous transverse rows, and are simple, stout, and well arched; no central spine was observed.

The anatomy of *Antiopa* has not only helped to a better understanding of the jaws of *Proctonotus*, but has likewise assisted to a more accurate knowledge of the arrangement of the hepatic vessels in this genus, than we had previously obtained merely from their examination through the transparent skin of the animal. In our specimen, the whole of these vessels were of a dark colour, and those in front could be pretty correctly traced in the living state, even to their origin; but the posterior ones were too obscure to be followed to the stomach. We have now, however, little hesitation in speaking of the relationship of these parts.

The stomach is situated rather backward in the body, and receives three hepatic trunks, two lateral and anterior, from above; one posterior and median, from below. Each of the lateral and anterior trunks, as soon as it leaves the stomach, divides into two branches, one of which passes forward, the other backward; these communicate with the papillæ placed in front, and more than half way down the sides. The posterior median trunk sends branches to the papillæ behind on both sides. The hepatic glands (fig. 13) are small, being scarcely half the length of the papillæ: they are fusiform, with the margins sinuous, each terminating above in a blind sac, and below, gradually tapering to form a long slender duct. No ovate vesicle was observed in the apex of the papillæ, communicating externally, as in *Eolis*. As in that genus, however, the gland is enclosed in a distinct sheath, which reaches to the top of the papilla, and which probably separates the blood that is sent to the aerating surface from that which goes to supply the gland. The papillæ are covered with vibratile cilia, which send the current off from the apices.

The heart is placed much further back than in *Eolis*. The auditory capsules contain about thirty otoliths, and the eyes are distinctly visible through the skin.





## Fam. 3, Plate 41.

*Figs. 1 to 5.*

### ALDERIA MODESTA, Lovén.

*A. ovata* sub-convexa, lutescens, fusco variegata; capite parvo; branchiis elliptico-oblongis, postice crescentibus; in seriebus 6-7 digestis; pede amplo, lateribus reflexis.

*Stiliger modestus*, Lovén, in Ofv. Kongl. Vetens. Akad. Förh., 1844, p. 49.

*Alderia amphibia*, Allman, in Brit. Assoc. Rep. for 1844.

*modesta*, Idem., in Ann. Nat. Hist., v. 17, p. 5.

Lovén, Index Moll. Scand., p. 8.

S. Bate, Notes Faun. Swans., p. 6, pl. 1, f. 1, 2.

For. and Hanl., Brit. Moll., v. 3, p. 611, pl. c.c.c., f. 1.

*Hab.* In salt marshes and shallow pools of salt or brackish water, on a muddy bottom. Near Skibbereen, county Cork, *Professor Allman*. Loughor Marsh, near Swansea, *M. Moggridge, Esq.* and *C. Spence Bate, Esq.*

*Body* about half an inch long, ovate, rather convex, pale yellow, varying from greenish yellow to yellowish fawn-colour, and often densely spotted with dark brownish-gray. *Head* very small, slightly notched in front, and produced at the sides into obtuse lobes. *Branchiæ* ovate oblong, obtusely pointed, yellowish, frequently blotched with dark gray, especially in front, and spotted with opaque white: the tips white. The papillæ are disposed in six or seven diagonal rows on the sides of the back, commencing at some distance from the head, and leaving all the front of the back bare, but approaching more nearly behind. They increase in size towards the central and posterior rows, the last extending beyond the tail. *Foot* very large, rounded before and behind; produced and turned upwards at the sides: it is of a deep yellow in the centre becoming paler towards the edges.

In the autumn of 1842, Professor Allman met with this curious little mollusk in great numbers in a salt marsh near Skibbereen, which was never, except at the highest spring tides, flooded by the sea. The following interesting account of it was published by him in the Annals of Natural History.\* "The day was bright and warm when I met with this curious little animal. Many had crept quite out of the water and were crawling over the moist fronds of *Enteromorpha intestinalis*, and seemed to delight in exposing their slimy bodies to the influence of the warm autumnal sun. Others swarmed on the mud in the little shallow pools of the marsh, when their ova were abundantly deposited in the usual gelatinous masses,

\* Vol. xvii, p. 1.

## ALDERIA MODESTA.

characteristic of the eggs of the nudibranchiate gasteropods, a fact which is of itself sufficient to prove that this strange semi-marine and even semi-aqueous habitat was quite natural to our little nudibranch. Their bodies were enveloped in an exceedingly abundant mucous secretion, which was poured out more copiously than I recollect to have witnessed in almost any other gasteropod, and which is perhaps in some way connected with their singular, almost amphibious habits." This species was again met with, in the same locality, in September, 1846, and Dr. Allman kindly forwarded specimens to us, which, though they unfortunately did not reach us alive, were sufficiently fresh to enable us to make drawings of them in their natural colours. The *Alderia* has since been met with in Loughor Marsh, near Swansea, where it was found by Mr. Moggridge and Mr. C. Spence Bate in 1850. The latter gentleman states\* that it was "first detected by Mr. Moggridge in the month of May, when it was on confervæ floating in the centre of a ditch made brackish by the occasional admission of sea-water. Later in the year, fructification having been completed, we found the animals crawling on the sides of the bank." From this locality we have been also kindly favoured with specimens.

The spawn of this little animal is very peculiar. The gelatinous envelope is rather broad and irregularly semicircular, but the chain of ova within is convoluted in a very curious manner, forming alternate loops on each side. This arrangement may be more readily understood by a reference to our figures than by description.

The species extends to Norway, where it was discovered by Professor Lovén.

Our figures were taken from dead specimens in a fresh state, assisted by the drawings of M. Lovén and Mr. C. Spence Bate.

Figs. 1, 2. Side and back views of *Alderia modesta*.

3. Two of the branchial papillæ, much enlarged.

4. Spawn.

5. A portion of the same, more highly magnified.

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\* Notes on the Fauna of Swansea, p. 6.

## Fam. 3, Plate 41.

*Figs. 6 and 7.*

### LOMANOTUS FLAVIDUS, ALDER AND HANCOCK.

*L. flavidus*; velo parvo tuberculato; tentaculis clavatis, intra vaginas tuberculatas retractilibus; branchiis parvis, papillois, fulvo-cinctis, ad latera dorsi utrinque in serie unicâ dispositis.

*Eumenis flavida*, Ald. and Hanc., in Ann. Nat. Hist., v. 18, p. 293.

*Lomanotus flavidus*, For. and Hanl., Brit. Moll., v. 3, p. 586.

*Hab.* Dredged in Lamlash Bay, Isle of Arran, *J. A.*

*Body* a quarter of an inch long, quadrilateral, lemon-coloured above, white beneath. *Dorsal tentacles* clavate, laminated, pale yellowish white, the sheaths set round the top with about six tubercles, the outer ones largest, each having a ring of fawn-colour. *Veil* very small, with four tubercular points. *Branchiæ* papillose, mostly very short, but three on each side, set at regular intervals, are larger than the rest and nearly linear; each papilla is encircled by a band of fawn-colour, one or two of the larger ones having a faint indication of a second band below. They are set on a slightly waved pallial ridge, commencing at the sides of the veil in front and reaching nearly to the tail. The sides of the body are white, with a few pale yellow markings. *Foot* nearly linear, transparent white, slightly tinted with purple-brown at the edges; the front is strongly grooved transversely, notched in the centre, and produced into long tentacular points at the sides.

The interest attached to this little mollusk on account of its shewing a modification of form in a very rare genus, induces us to give figures of it, although we are obliged to place them out of the regular order.

Only three species of *Lomanotus* have yet been discovered. In *L. Genei*, of Verany, a species nearly two inches and a half long, the branchiæ form foliaceous expansions of the pallial ridge: in our *L. marmoratus* the same character is apparent; but in the present species the pallial margin is very indistinct and the branchiæ begin to assume the form of regular papillæ, indicating a nearer approach to the typical forms of the family *Eolididæ*.

We obtained the only known example of this species on a small *Antennularia* brought up by the dredge from three or four fathoms water, in Lamlash Bay. Unfortunately, it was a little injured, and did not long survive.

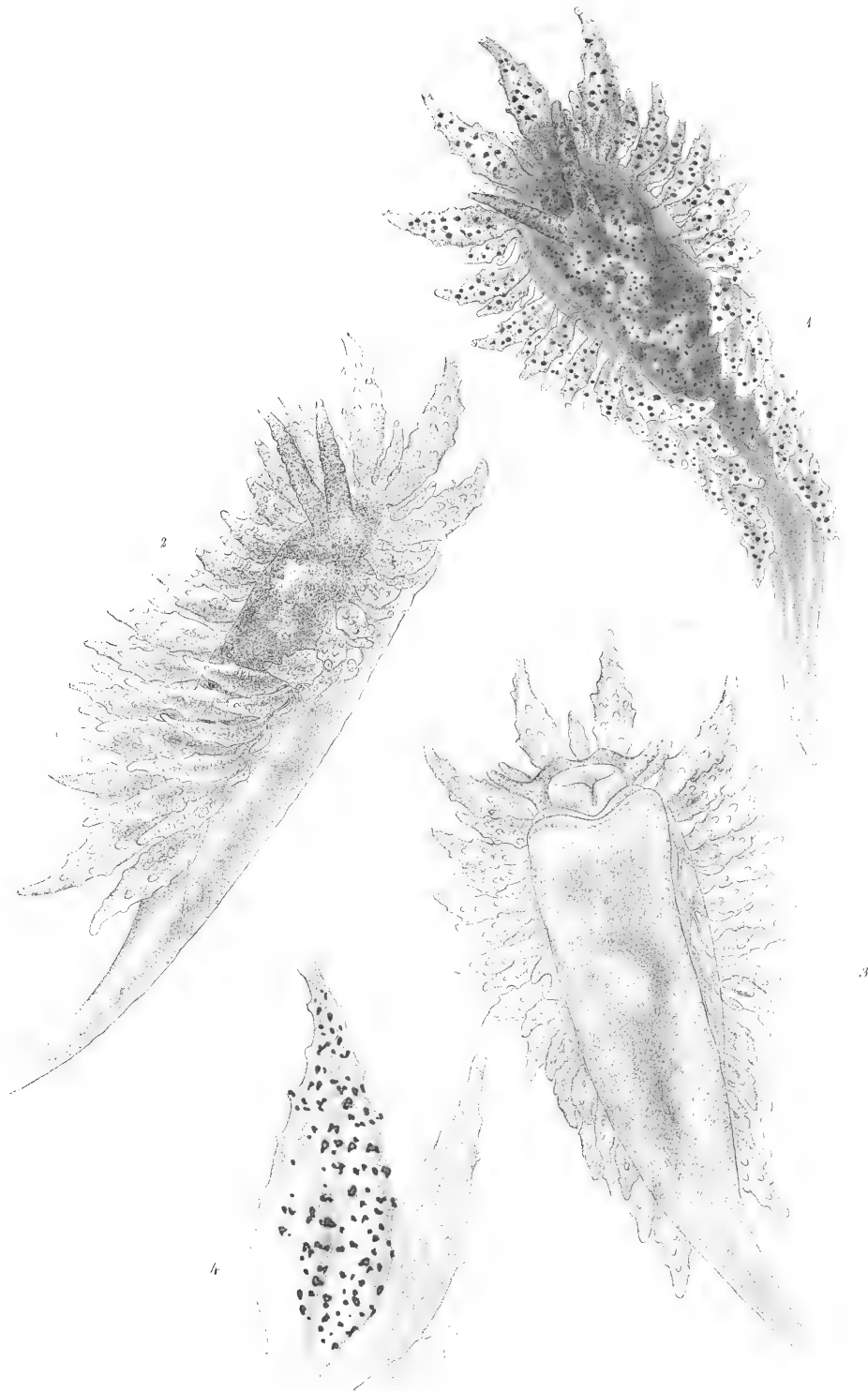
Fig. 6. *Lomanotus flavidus*, back view.

7. Anterior portion of the under side.









C. Hulmandel's Patent Lithogr.

H. del.

PROCTONOTUS MUCRONIFERUS.

Fam. 3, Plate 42.

PROCTONOTUS MUCRONIFERUS, ALDER and HANCOCK.

*P. ovatus fulvius*, brunneo-marmoratus: branchiis ovatis, hyalinis, tuberculatis, in seriebus 12, utrinque ad marginem dorsi dispositis: papillis 4, magnis, frontalibus: tentaculis dorsalibus subtuberculatis.

*Venilia mucronifera*, Ald. and Hanc. in Ann. Nat. Hist. v. 13, p. 161, pl. 2.

*Proctonotus mucroniferus*, Ald. and Hanc. in Ann. Nat. Hist. v. 13, p. 407.

*Hab.* In shallow water, Malahide Bay, near Dublin.

*Body* nearly half an inch long, ovate, rather broad and depressed, subtruncated in front, and produced behind into a long pointed tail; the sides flattened or concave, projecting in a ridge above. The back is slightly rugose, of a pale yellowish brown colour, clouded and freckled with darker brown, and covered with minute opaque white spots; the rest of the body is hyaline white, nearly colourless, having a few small brown spots on the head and sides, and more numerous opaque white ones over the whole surface. *Head* with a semicircular veil, strongly notched in front, and bearing two short cylindrical tentacles at the sides. *Dorsal tentacles* of a purplish brown colour, with darker freckles, rather long, stout, and slightly conical, irregularly wrinkled and somewhat tuberculated; their bases nearly approximate, the points stand apart and are inclined forwards. Eyes rather large and placed as usual. *Branchiæ* ovate or inversely pear-shaped, produced into blunt and flattened apices, and having large, rather distant tubercular points over the whole surface. They have a crystalline appearance, being very transparent and nearly colourless, sprinkled with opaque white spots. The central vessel is small and not half the length of the papillæ. It is yellowish, granular, and elliptical, tapering to a slender duct below. The branchiæ are set along the projecting ridge on each side of the back, in twelve transverse rows of three very close-set papillæ each; those next the back large and inflated, the exterior ones very small; two larger than the rest are placed posteriorly. These lateral rows are united anteriorly by four large, elliptical, tuberculated papillæ, apparently of a similar nature with the others, which pass round the head in front of the dorsal tentacles, and alternate with five smaller ones below. *Foot* rather broad and ovate, tapering to a fine point behind, transversely grooved and bilobed in front, but not produced into angles; it is pellucid, with a portion of the gastric system seen through, yellowish, and minutely spotted with opaque white.

A single perfect specimen of this curious animal, and another much injured, were dredged up in Malahide Bay, in September, 1843, adhering to a sponge (*Halichondria panicea*) from rather shallow water. The first lived with us for two or three weeks. It turned sickly soon after it was caught and lost several of its larger papillæ: some of these were afterwards reproduced and grew very rapidly; but the papillæ on the front of the head, which were amongst those that had fallen off, never reappeared, so that we were prevented

PROCTONOTUS MUCRONIFERUS.

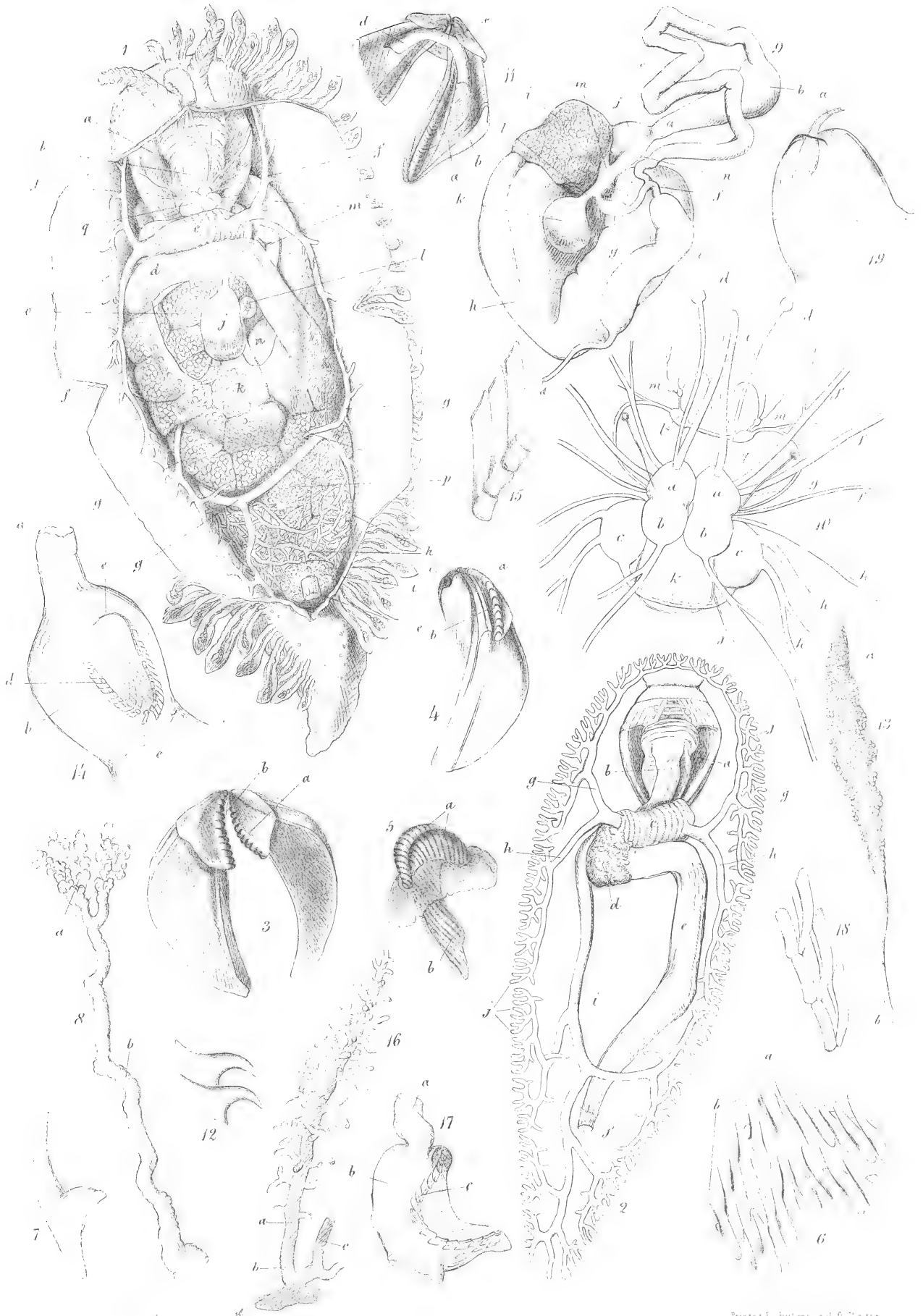
from satisfactorily ascertaining their functions; they seemed to want the central coloured vessel of the lateral papillæ, but perhaps might be considered equally with the others to perform the office of branchiæ. Our captive was not of active habits; it moved seldom and never quickly, and when it floated in the usual inverted position, which it did occasionally, it made no exertion whatever to assist its progress.

- Fig. 1, 2, 3. *Proctonotus mucroniferus* in different positions.  
4. A row of the papillæ more highly magnified.











## Fam. 3, Plate 43.

### GENUS 10. ANTIOPA,\* ALDER and HANCOCK.

*Corpus* ovato-oblongum, postice acuminatum. *Caput* subinferius, velo parvo obtectum. *Maxillæ* corneæ. *Tentacula* 4, quorum 2 majora, dorsalia, et 2 minora labialia. *Tentacula* dorsalia laminata, basibus cristæ arcuatæ centrali conjunctis. *Branchiæ* papillosæ, ovatæ, utrinque ad marginem lateralem et prominentem dorsi dispositæ, et antè circum caput collocatæ. *Anus* posticus, in lineâ mediâ dorsi situs. *Apertura* genitalis ad latus dextrum.

The principal character which induces us to consider this genus distinct from *Proctonotus* is the remarkable crest between the dorsal tentacles, a character so peculiar as apparently to warrant a generic distinction. The lamellated form of the tentacles, and the length and bifid termination of the glands of the papillæ, may possibly prove to be of generic importance; but from our present imperfect knowledge of these animals, confined in each genus to a single species, and in *Proctonotus* to a single perfect specimen, we can scarcely determine the value of these characters, nor the extent of their variation, with any degree of certainty. The genus was first described by M. Verany of Genoa, in the 'Revue Cuvierienne,' for 1844, under the name of *Janus*, a name previously appropriated by Mr. Stevens to a genus of Hymenopterous insects in 1835. At the time when we proposed for it the generic appellation here adopted,† we had not the means of ascertaining its identity with the *Janus* of M. Verany, which we have since had ample opportunity of doing through the kindness of that distinguished naturalist; but, adopting the views expressed in the rules for zoological nomenclature, published by the British Association, as to the propriety of discarding duplicate names, we have retained the name of *Antiopa* in preference to that of *Janus*, which, under other circumstances, would have been entitled to priority.

The body in this genus is ovate, rather depressed, and tapering to a point posteriorly. It has a produced ridge on each side assuming the appearance of a rudimentary cloak. The dorsal tentacles are laminated, non-retractile, and united at the base, and for a short way up, to an arched fleshy crest. The head is inferior, subangular in form, and without a veil, but having the margin of the lips projecting considerably, with two small linear or cylindrical oral tentacles. The mouth is provided with strong horny jaws, and a broadish denticulated tongue. The branchiæ are papillose and elongated, arranged round the head and down each side of the back, nearly meeting behind. At their posterior termination, a median ridge runs down to the tail. The anus is situated posteriorly on the median line of the back, a little in advance of the termination of the branchiæ. It is tubular and conspicuous. The foot is

\* A classical proper name.

† Ann. Nat. Hist., 2d series, v. 1, p. 190.

## ANTIOPA.

rather broad and expanded; deeply grooved in front, and terminating in a point behind. The aperture of the genital organs is placed near the middle of the right side.

The single species on which this genus is founded occurs on the coast of Italy and on the southern shores of England. It belongs to the Laminarian, and perhaps extends into the coralline, zone; it is undoubtedly carnivorous, as we have taken from its stomach the remains of some mollusk, probably that of a nudibranch.

A detailed account of the anatomy of this genus has been published by M. Blanchard in the 'Annales des Sciences Naturelles;'<sup>\*</sup> the following description of its internal structure, however, is derived entirely from our own examination of specimens procured from both the Mediterranean and the British shores; and it will be seen that, in several important particulars, we are unfortunately at variance with that naturalist.

The genus varies much in its anatomy from *Eolis*. The buccal mass (Pl. 43, figs. 1 *a* and 2 *a*) is exceedingly large, a little depressed, and somewhat lozenge-shaped. The jaws (figs. 3, 4) are likewise of great magnitude, and are not mere thin laminæ; but are of considerable thickness, of a triangular form, and each is furnished in front with a powerful denticulated cutting plate (*a*), having, immediately within and parallel to it, another cutting edge (*b*), which is plain. The tongue (fig. 5) is broad, and formed as in *Doris*, with the posterior portion tubular. The spines (figs. 6, 7), which are simple, are, in *A. cristata*, arranged in thirty transverse rows, inclined forward, each row containing eighty spines, and there is a central, equally large and plain spine in each row.

The œsophagus (fig. 2 *b*) is wide, internally plicated, and very short; it opens into a distinct gastric pouch or stomach (*c*), placed in the anterior portion of the body. The stomach is transversely elongated, and has the upper wall so thin and delicate, that the internal plicæ are distinctly seen through it. On the lower portion, and towards the left side, where the intestine leaves the stomach, there is a thin coating of a glandular structure (*d*). The intestine (fig. 1 *d*, fig. 2 *e*) is very wide, and doubling back upon the stomach, passes diagonally to the right side of the body, down which it is continued for some distance, and then, dipping beneath the posterior lobe of the ovary, reaches the large anal nipple, (fig. 1 *e*, fig. 2 *f*) on the median line of the back near the posterior extremity.

Two principal hepatic trunks open into the sides of the stomach above. On leaving that viscus, these almost immediately divide into two branches; the anterior (fig. 2 *g*, *g*) of which pass round in front of the head, and are united on the median line. These two branches communicate by various ramusculæ, with the glands of the anterior papillæ. The other or posterior branches (*h*, *h*) of these hepatic trunks curve backward, and are connected in like manner to the numerous papillæ on the sides, extending more than half way down the body. Here these branches terminate. The posterior papillæ of both sides communicate with a median trunk tube (*i*), which, dipping under the anterior ovarian lobe on the left side, passes forward, and opens into the lower glandular aspect of the stomach, a little in advance of where the intestine leaves it. All the principal trunks and branches are of a dark colour, when the animal is alive. The median trunk tube corresponds to the great central hepatic duct in *Eolis*, while the branches from the upper surface of the stomach are equivalent to the anterior ones of that genus, which always open into the dorsal aspect of the digestive sac.

\* 3d Series, vol. x, p. 72.

## ANTIOPA.

M. Blanchard does not appear to be aware that any such median trunk tube exists in this animal; we have, however, on more than one occasion determined its presence by actual dissection.

The hepatic gland of the papillæ (fig. 8) is peculiar in its structure; it is comparatively small, and lies within an inner sheath; the lower portion is narrow and tubular, the termination bifid, with each division slightly branched and folliculated, forming a beautiful example of glandular organisation reduced to its simplest element. Delle Chiaje has described a terminal vesicle with urticating filaments in the apex of the papillæ, as in *Eolis*. This has escaped our observation, though a distinct external orifice was visible in the living state.

The glands of the papillæ do not appear to be the only representative of the liver in this genus. On each side of the lower portion of the body, immediately within the skin, there is a peculiar glandular structure, composed chiefly of anastomosing tubes (fig. 1 *h, h*), which form a network across the dorsal aspect in front of the anus. This network inosculates with the minute hepatic branches leading to the papillæ, and is also apparently connected with a dense gland-like body (*i*), surrounding the termination of the intestine. There can be little doubt that this network of tubes is a part of the hepatic organ; and from its internal position, it points out *Antiopa* as one of the intermediate forms uniting the *Eolididæ* with the other two families of the order. The tongue, also, of this genus is interesting, as evincing the same fact.

The vascular system apparently resembles that of *Eolis*, with the exception of some variation in the disposition of the branchio-cardiac vessels. We have observed two trunk-veins opening into the posterior margin of the auricle, and M. Blanchard represents several. In the *Eolidæ* there is only one trunk-vein so situated; neither is there anything like this arrangement in either *Doris* or *Tritonia*. The heart is placed about the middle of the back, directly below the skin; having the intestine in front, and the ovary beneath. The ventricle (fig. 1 *j*) is large and strong, the auricle (*k*) thin and delicate; they are contained within a pericardium of great tenuity, having, lying beneath its floor, a vesicle (*l*), which in *Doris* we have called a portal heart. In this instance, the vesicle opens through the lower wall of the pericardium in the same manner as that does in *Doris*; and, as in that genus, its internal surface is plicated. We have not been able to carry the comparison further; but suppose that this additional heart in *Antiopa* may supply the internal hepatic network with venous blood, and perhaps also the glands of the papillæ.

The branchial papillæ are very delicate, large, and numerous in this genus. They will undoubtedly be assisted in aerating the blood by the general surface of the body.

The cerebroid and branchial ganglia (figs. 10 *a, a, b, b*) are fused into one, and thus, on each side of the median line, there is an elongated mass, as in *Eolis*; but being more distinctly bilobed, the constituent parts are easily determined.

The pedial ganglia (*c, c*) are almost circular, and are placed external to, and only a little below, the others. The olfactory nerves (*e*) are very large, and come, as usual, from the upper surface of the cerebroid ganglia; they divide into two portions, those next the median line converge and go to supply the crest at the base of the dorsal tentacles; the other portions are sent to the tentacles themselves, within the base of which they terminate in the olfactory ganglia (*d, d*). These are of a circular form.

There is nothing peculiar in the other nerves of the supra-œsophageal ganglia, except

## ANTIOPA.

that the optic nerve (*g*) is of considerable length. The nerve (*j*), supplying the reproductive organs, comes off from a delicate collar, which has its two ends inserted apparently into the branchial ganglia at their junction with the pedial, just where the visceral ganglion is situated in *Doris*. This arrangement is the same as in *Eolis*. Ten or eleven pairs of nerves have been ascertained to belong to the supra-œsophageal ganglia.

The infra-œsophageal ganglia are placed much further apart than usual, having the median commissure very wide; the cords, too, that unite them to the cerebroid ganglia are very long. The gastro-œsophageal (*m*, *m*<sub>1</sub>) are joined to the buccal ganglia (*l*, *l*<sub>1</sub>) by short nerves, giving the former a pedunculated character: they send three pairs of nerves to the œsophagus, the two principal of which supply that tube, one passing down it.

Portions of the sympathetic nervous system have been distinctly traced on the generative organs,\* and will in all probability be found on the other viscera.

The eye seems to be as well developed as in any of the nudibranchs; and from the high development of the dorsal tentacles, and the crescentric enlargement of their base, olfaction would appear to be extensively enjoyed. The auditory organ was not examined by us, but M. Blanchard places it in the usual situation immediately behind the optic nerve.

The reproductive apparatus fills the greater portion of the body; and is provided with a very large intromittent organ (fig. 9 *b*), which receives one end of a short, stout, tubular testis (*c*); the other end of the testis tapers a little before it joins the oviduct. The ovary, which fills much of the cavity of the body, is composed of two lobulated masses, one (fig. 1 *o*) a little in advance of the other (*p*). The oviduct (fig. 9 *d*) is at first very slender; but as soon as it reaches the mucus-gland, it greatly and suddenly increases in diameter (*e*), and as it approaches, in a tortuous course, the anterior border of that organ, it as rapidly diminishes almost to its original caliber. It then shortly after doubles upon itself (*f*), and is connected with the testis; afterwards the oviduct is again a little dilated (*g*), as it draws near to the spermatheca (*h*), which is rather small. The duct (*l*) of the spermatheca is short and constricted; but, after its junction with the oviduct, is enlarged, and sends a short branch (*m*) down into the mucus-gland. This duct, which must now be considered the vagina (*n*), passes on in a straight line to the external opening between the male and the female outlets. In this animal there is no accessory spermatheca; but the two dilated portions of the oviduct appear amply sufficient to make up for the deficiency. Perhaps the enlargement of the oviduct at its junction with the duct of the spermatheca may more particularly subserve the function of a second receptacle. The mucus-gland (*h*, *i*), which is pyriform and somewhat compressed, resembles the same organ in *Doris* more than that of *Eolis*.

\* Traces of the sympathetic nervous system have been observed on the reproductive organs and on the stomach of *Eolis*, since the description of that genus was drawn up.

## EXPLANATION OF THE PLATE.

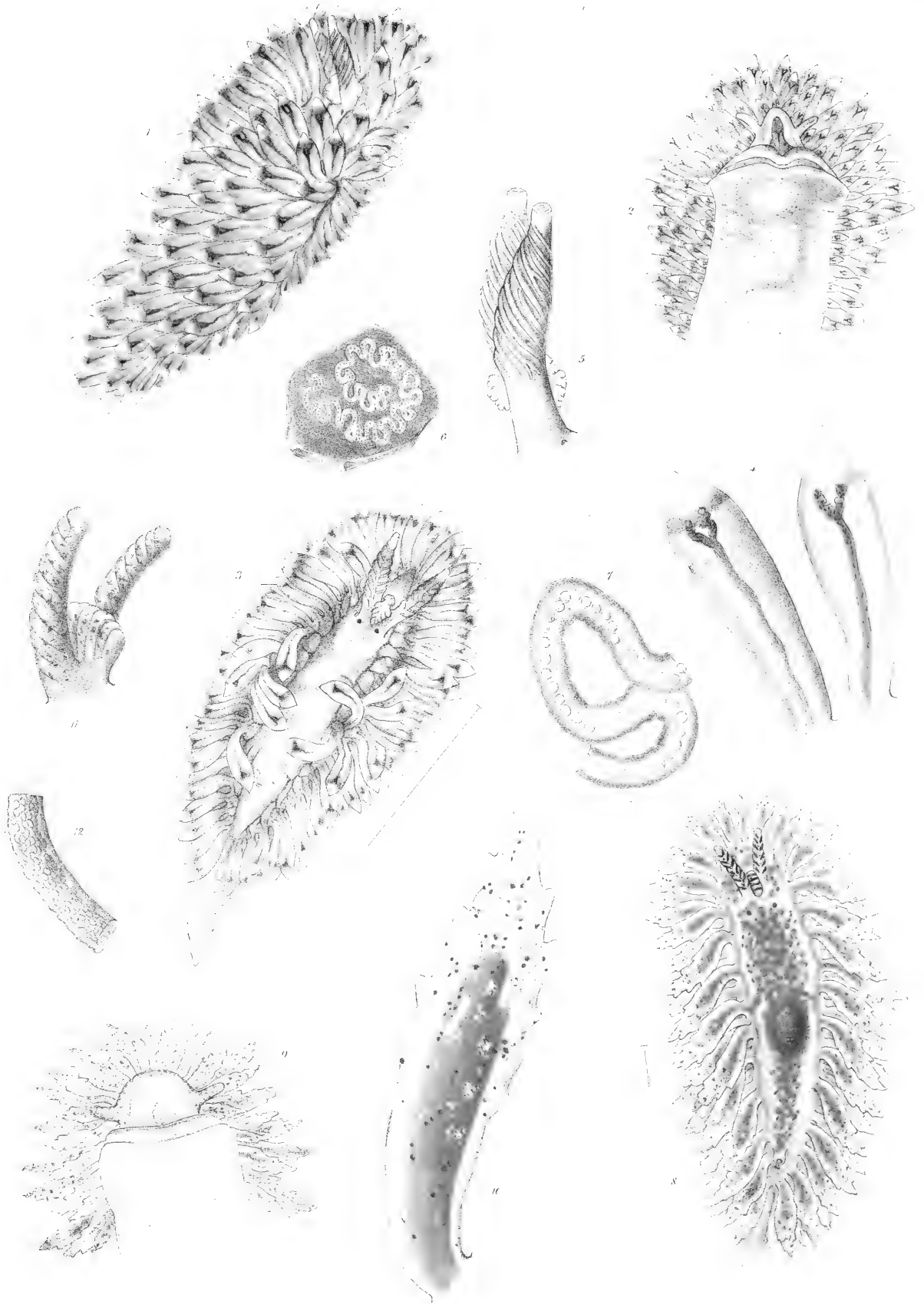
Fig. 1. General view of the viscera of *Antiopa cristata*, the dorsal skin having been removed:

- a*, buccal organ; *b*, œsophagus; *c*, stomach; *d*, intestine; *e*, anal nipple; *f, f, f, f*, anterior hepatic trunk-tubes; *g, g, g*, branches from the median hepatic trunk-tube; *h, h*, net-work of tubes in connexion with the ramuscles of the hepatic system; *i*, a dense glandular mass surrounding the termination of the intestine, apparently in connexion with the hepatic system; *j*, ventricle of the heart; *k*, auricle; the oval shadowing marks the extent of the pericardium; *l*, small vesicle or portal heart, opening through the floor of the pericardium; *m*, portions of the male generative organ; *n*, mucus-gland in connexion with the female channel; *o*, anterior lobe of ovary; *p*, posterior lobe of the same; *q*, supra-œsophageal ganglia, with various nerves passing from them.
2. Digestive apparatus of *Antiopa cristata*, with the hepatic glands of the papillæ and the net-work of hepatic tubes removed: *a*, buccal organ; *b*, œsophagus; *c*, stomach; *d*, glandular portion of the same; *e*, intestine; *f*, anal nipple; *g, g*, anterior branches of the anterior hepatic trunk-tube; *h, h*, posterior branches of the same; *i*, median hepatic trunk-tube giving branches to the papillæ of either side on the posterior portion of the body; *j, j*, ramuscles leading to the glands of the papillæ.
  3. Under or front view of the jaws of *Antiopa cristata*: *a*, anterior plate with denticulated cutting edge; *b*, plain inner cutting edge.
  4. A single jaw of the same, viewed with the cutting edges in front: *a*, denticulated cutting edge; *b*, plain inner cutting edge; *c*, point of articulation.
  5. Tongue of *A. cristata*: *a*, exposed portion exhibiting rows of spines; *b*, tubular portion of the same.
  6. Central portion of two rows of lingual spines: *a*, central spine; *b*, lateral spines.
  7. A single lateral spine a little more enlarged.
  8. Hepatic gland, removed from papilla; *a*, terminal folliculated portion; *b*, stem or duct.
  9. Generative organs spread out, the ovary having been removed: *a*, channel of the penis leading to external orifice; *b*, retracted penis; *c*, testis; *d*, constricted portion of the oviduct, as it leaves the ovary; *e*, dilated portion of the same; *f*, the point where it communicates with the testis; *g*, second dilatation of the oviduct; *h*, semi-pellucid portion of the mucus-gland in connexion with the female channel; *i*, opaque portion of the same; *j*, female channel leading to external orifice; *k*, spermatheca; *l*, duct of the same; *m*, branch of the duct leading into the mucus-gland near to the female channel; *n*, external channel or vagina leading to the spermatheca.
  10. Cerebral or cephalic ganglia: *a, a*, cerebroid ganglia; *b, b*, branchial ganglia; *c, c*, pedial ganglia; *d, d*, olfactory ganglia; *e*, inner portion of the olfactory nerve, supplying the crest at the base of the tentacles; *f, f, f*, nerves from the cerebroid ganglia, supplying the lips and channel of the mouth; *g*, optic nerve and eye; *h'*, nerve to side of body; *h, h*, pedial nerves; *i*, branchial nerve, supplying the sides of the back at the base of the papillæ; *j*, genital nerve, given off from a delicate nervous collar; *k*, great œsophageal collar; *l*, buccal ganglia; *m*, gastro-œsophageal ganglia, each giving off three nerves, which pass to the œsophagus.

## ANTIOPA.

- Fig. 11. Jaws of *Proctonotus mucroniferus*: *a* and *b*, the two parallel plates; *c*, anterior cap or plate; *d*, horny arch uniting the jaws.
12. Two of the spines from the tongue of *Proctonotus*.
13. Hepatic gland from a papilla of *Proctonotus*: *a*, glandular portion; *b*, duct.
14. Buccal organ of *Hermæa dendritica*, as seen in the compressor: *a*, œsophagus; *b*, buccal organ; *c*, oral opening; *d*, tongue; *e*, anterior attenuated termination of the same.
15. Three spines from the tongue of *Hermæa dendritica*.
16. Hepatic gland from a papilla of *Hermæa bifida*: *a*, central stem or duct; *b*, transparent belt on the same, marking the place of sphincter; *c*, a portion of the central duct, exhibiting the sphincter in a state of contraction.
17. Buccal organ of *Alderia modesta*: *a*, œsophagus; *b*, buccal organ; *c*, tongue.
18. Three spines from the tongue of the same.
19. Penis of the same: *a*, crystalline spur at the apex of the intromittent organ.





J. Alder and A. Hancock del.

W. W. H. & Co. Lith. & Print. Imp.

Fig 1-7 ANTHOPA CRISTATA. Fig 8-12 ANTHOPA HYALINA



### Fam. 3, Plate 44.

*Figs. 1 to 8.*

#### ANTIOPA CRISTATA, DELLE CHIAJI, Sp.

A. ovata, postice attenuata, pallidè fulva, pellucida; branchiis numerosis, ovato-oblongis, inflatis apicibus opacis, cæruleis, glandulâ centrali brunneâ, lineari, supernè furcatâ; tentaculis dorsalibus subconicis, valdè laminatis; tentaculis labialibus parvis linearibus.

*Eolis cristata*, Del. Chia., Desc. Stor. Anim. Nap., pl. 88.

*Janus Spinolæ*, Verany, Catal. Inv. Genova, p. 24, pl. 2, f. 9.

Blanchard, in Ann. des Scien. Nat., 3<sup>me</sup> Ser., v. 11, p. 77.

*Antiopa splendida*, Ald. and Hanc., in Ann. Nat. Hist., 2d Ser., v. 1, p. 190.

Spence Bate, Notes Faun. Swans., p. 7, pl. 2.

For. and Hanl., Brit. Moll., v. 3, p. 609, pl. B. B. B., f. 6.

*Hab.* Torbay, Dr. Battersby. Fowey Harbour, Cornwall, J. A. Langland Bay, South Wales, M. Moggridge, Esq. Barricane, near Ilfracombe, P. H. Gosse, Esq. Menai Straits, J. A.

*Body* about an inch and a half in length, ovate, rather depressed, and tapering to a fine point behind, of a delicate lemon-yellow inclining to buff or fawn-colour, very transparent, sometimes nearly white. *Dorsal tentacles* conical, a little bent in front, and truncated at the top, yellow with white tips. They are strongly laminated in an oblique direction, the laminae uniting in a ridge behind. The tentacles are united at the base, for about a quarter of their height, by an arched crest of a semicircular form, a good deal sinuated and lobed, narrow on the top, and spreading out before and behind; the sides shew a radiating structure. *Oral tentacles* short and linear, set on the sides of the head, which is of a conical form, the lips overhanging the mouth like a hood. *Branchiæ* very numerous, ovate-oblong, rather abruptly pointed. They are capable of great inflation, and are of the same colour as the body, and very transparent, shewing a narrow, brown, central gland, which is bifurcated and sacculated at the top. The apices are opaque bluish white, deepening into ultramarine blue, and have a brilliant metallic lustre. The papillæ are thickly set on the sides of the back and round the head in front, on a pallial ridge, without apparent order, meeting posteriorly a little behind the tubular anus, from whence a line of white runs down to the tail. The papillæ near the foot are small and much crowded; those towards the centre of the back are large, and when the animal is crawling, nearly conceal the whole of the body. The back is generally blotched and spotted with bluish white, having the same metallic lustre as the tips of the papillæ. The gastro-hepatic vessels are very distinctly seen through the skin, forming two brown lines down the sides of the back, with ramifications running into the papillæ. *Foot* rather broad, thin at the edges, and deeply grooved in front, so as to form two distinct laminae; the upper one of which is strongly notched in the centre; the lower rather less so; it is a little convex in

## ANTIOPA CRISTATA.

outline, terminating at the sides in obtuse angles scarcely produced. The colour is transparent white or yellowish.

This splendid animal was dredged in Torbay, by Dr. Battersby, whence it was sent us through the kindness of Mrs. Griffiths. We have since met with it in Cornwall and North Wales, and Mr. Moggridge and Mr. Gosse have each obtained a specimen on the shores of the Bristol Channel. It appears, therefore, to be pretty generally diffused on the southwestern shores of our island. It is one of the few species we possess common to England and the Mediterranean, and is probably a southern form that here reaches its northern limits, as in the Mediterranean, where it is more common than with us, it attains a larger size. The specimens we dredged in the Menai Straits, were scarcely more than half the size of those on the southern coast.

This is a very active animal, moving about with great grace and elegance. The branchial papillæ are then in constant motion, and when seen on a dark ground, their brilliant tips stand out conspicuously, and appear like a cluster of gems. We have observed an aperture at the end of each papilla, visible with a common pocket lens, which, when the animal is in a lively state, is frequently opened and closed alternately: when open, the apex assumes a rounded outline, but it terminates in a sharp point when the aperture is closed: the latter is the usual form when the animal is at rest. This action is probably connected with the discharge of urticating filaments, as in the *Eolides*, but we could not detect anything issuing from the aperture at the time.

The spawn of this species, for a drawing and description of which we are indebted to Mr. Gosse, presents some peculiar features. It consists of a transparent gelatinous thread, deposited in tortuous undulations, which Mr. Gosse aptly compares to a succession of figures of 8. These are arranged in the usual spiral form. The ova are in single series, and are transparent globules, appearing at first about two thirds filled with opaque white specks, in the form of a crescent. "About five days after deposition," Mr. Gosse informs us, "the white specks in the globules had filled the whole interior," and on examination under a microscope, "each globule was seen to be a chorion of gelatinous membrane containing more than sixty active little nautiloids." Usually the ova of the Nudibranchs are crowded together in numerous rows throughout the gelatinous envelope, each egg having a single embryo, or at most three or four. Here, however, there is only a single row of eggs, but the apparent deficiency of numbers is made up by each egg containing numerous embryos: the whole amounting, according to Mr. Gosse's calculation, to 45,000.\*

Fig. 1, 3. Side and back views of *Antiopa cristata*.

2. Under side of the anterior portion of the same.

4. Two of the papillæ.

5. Dorsal tentacles with crest.

6. Spawn.

7. A portion of the spawn enlarged, shewing the arrangement of the eggs.

\* See 'A Naturalist's Rambles on the Devonshire Coast,' p. 325.

## Fam. 3, Plate 44.

*Figs. 8 to 12.*

### ANTIOPA HYALINA, ALDER AND HANCOCK.

*A. elliptica*, postice attenuata, pellucida, pallidè lutescens, rufescenti-fulvo longitudinaliter in medio dorso notata; branchiis ellipticis, tuberculatis, hyalinis, glandulâ centrali fulvâ, lineari; tentaculis dorsalibus linearibus, obtusis, obscurè laminatis; velo capitali arcto, tentaculis 2 brevibus instructo.

*Hab.* Hilbro Island, mouth of the Dee, Cheshire, *J. Byerley, Esq.*

*Body* three tenths of an inch in length, elliptic-oblong, very transparent, yellowish, with reddish brown markings. *Dorsal tentacles* rather short, linear, a little curved backwards, obtuse and rounded above, with about ten oblique rather obscure laminæ, reaching very close to the apex; yellowish fawn-coloured, spotted with brown and white. They are united at the base by a semicircular crest of the same colour, with transverse lobules, giving it a radiated structure at the sides. The crest rises to about one third the height of the tentacles. *Oral tentacles* very short, linear-conical, set on a narrow semicircular veil that surrounds the head. Back pale transparent yellow, thickly spotted and blotched down the centre with bright reddish brown. *Branchiæ* numerous, elliptic-oblong, tapering to a blunt point, and tuberculated or mucronated on the upper part. They are of a hyaline transparency, showing a rather stout fawn-coloured central vessel, reaching about two thirds up. The surface is spotted with brown and opaque white, with blotches of the latter on the tubercles. The branchiæ are densely arranged on a pallial ridge down the sides of the body, and round the head, without forming regular rows. They meet behind the anus, concealing the posterior extremity. *Foot* strongly grooved in front, with the lateral angles rounded. It tapers to a point behind.

This interesting mollusk was obtained by Mr. Byerley when dredging at the mouth of the Dee in the summer of 1851. Though a true *Antiopa*, from the laminated tentacles and dorsal crest, this animal shows a very close approach to *Proctonotus mucroniferus* in the tuberculated branchiæ and small frontal veil. Its colour, too, reminds one a good deal of that single known species of *Proctonotus*. Reviewing the two genera again, since the acquisition of this species, we find no character to distinguish them from each other but the dorsal crest, and laminated or unlaminated tentacles. The former feature, however, is so peculiar that we still feel ourselves justified in keeping them apart.

The spawn forms a cylindrical cord, loosely convoluted like that of *Dendronotus*. The ova are white, without particular arrangement, and almost filling the gelatinous envelope.

Fig. 8. Back view of *Antiopa hyalina*.

9. Under side of the anterior portion of the same.

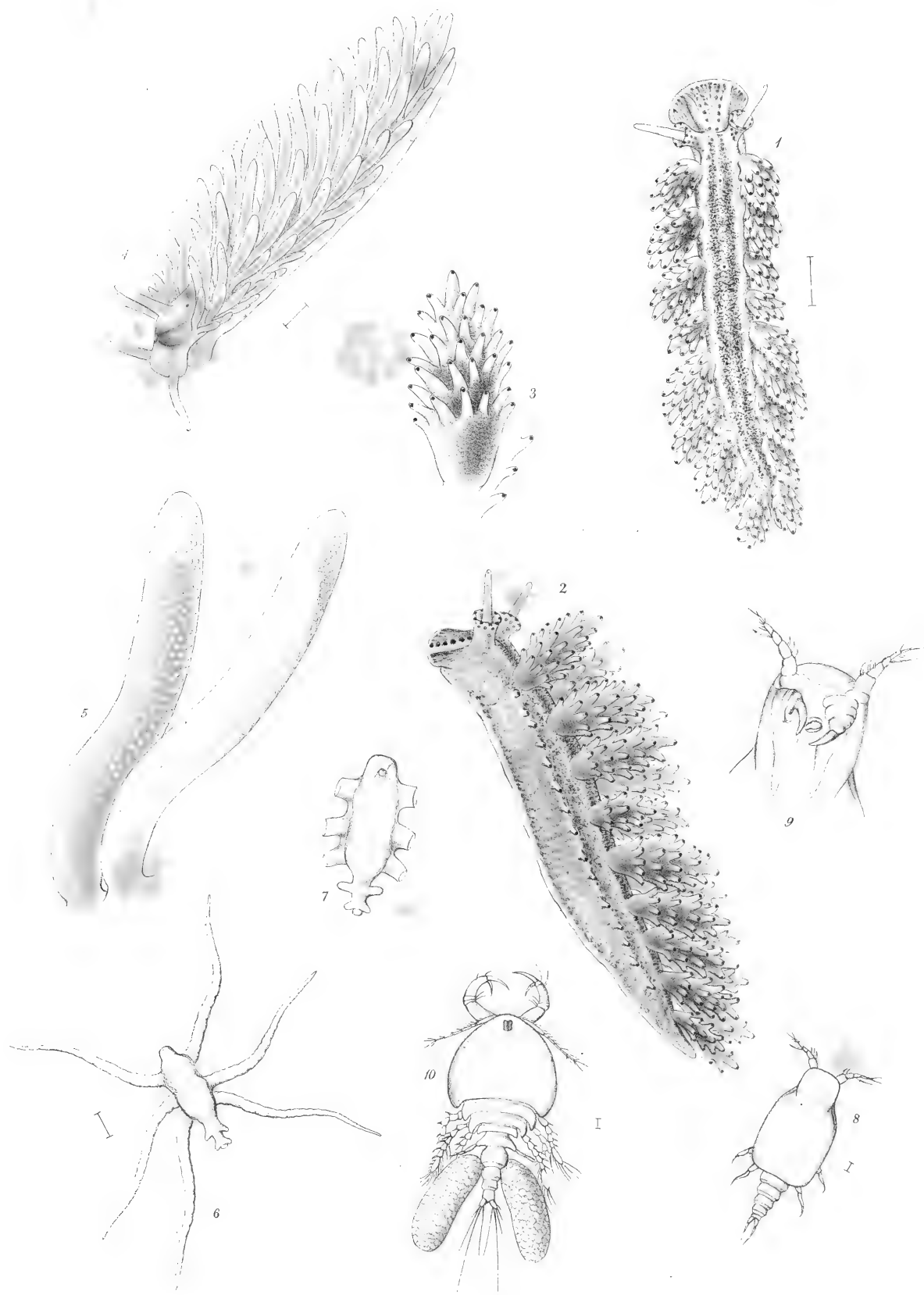
10. A papilla much enlarged.

11. Dorsal tentacles with crest.

12. A portion of the spawn.







J. Alder & A. Hancock del. W. Wing lith.

Ford & West Imp.

Fig. 1-3. *DOTO PINNATIFIDA*. Fig. 4-5. *EOLIS PUSTULATA*. Fig. 6-10. PARASITES.

Fam. 3, Plate 45 (supplementary).

*Figs. 1 to 3.*

DOTO PINNATIFIDA, MONTAGU, sp.

*D. flavescens* vel olivacea, fusco et nigro maculata; velo arcuato, fastigiis 2 lateralibus; branchiis utrinque 7—9 ovato-conicis, tuberculis gracilibus, nigro-punctatis, obsessis.

*Doris pinnatifida*, Mont., in Linn. Trans., v. 7, p. 78, pl. 7, f. 2, 3.

*Tritonia pinnatifida*, Flem., Brit. Anim., p. 284.

*Hab.* Devonshire coast, *Montagu*. St. Peter's Port, Guernsey, *J. A.*

*Body* four tenths of an inch long, nearly linear, slender, of a yellowish olive colour, inclining to rufous on the sides, and profusely spotted with brown and black. *Tentacles* filiform, moderately long, yellowish, or nearly colourless, issuing from sheaths a little expanded at the top, and surrounded at the edge with one or two rows of black spots; there are also a few black spots on their sides, running into vertical lines posteriorly. *Veil* a good deal arched and rather deep, spotted with brown and black, especially towards the margin. There is an elevated ridge running from the base of each tentacle to the anterior margin of the veil; a row of black spots extends along the inside of each ridge, and these are continued less conspicuously between the tentacles, joining two irregular bands of brown and black spots that run down the back to the tail. The intervening space on the back is spotted and marbled with brown, and contains two or three scattered tubercles with black tips. *Branchiæ* from seven to nine pairs, extending very close to the tail. They are ovate-conical, slightly pedunculated, and set with five or six transverse rows of slender papillary tubercles, commencing a little from the base, with a terminal one at the apex. The tubercles are slender and very extensile, and are of a pale yellowish colour, each surmounted by a black spot. The general colour of the branchiæ is a brownish olive, having a granular appearance in the centre: the base is reddish. The sides of the body are pale greenish yellow, with a reddish tinge towards the centre. They are spotted and marbled with blackish brown, forming a line near the foot and another at the base of the branchiæ, where there is also a row of small papillary tubercles of a palish hue, with black tips, extending down each side to the tail. *Foot* narrow, a little arched in front, with the sides slightly produced and rounded.

The re-discovery of this long-lost species of Montagu settles the doubts that had been entertained respecting its distinctness from *D. coronata* and *D. fragilis*, to each of which it has been referred. Not succeeding in our attempts to find it on the Devonshire coast—the

## DOTO PINNATIFIDA.

original locality,—where *D. coronata* is not uncommon, we had come to the conclusion that it was probably a variety of that species, an opinion which we now think erroneous, though the two are so nearly related, that in spirits they can scarcely be distinguished from each other. *Doto pinnatifida*, however, appears to be a good species, intermediate in its characters between the two more common kinds, but possessing additional characters of its own, sufficient to separate it from them. Of these, the arched veil, the slender papillose tubercles of the branchiæ, the profuse spotting of the black, and the row of black-tipped tubercles on the sides of the body, are the most conspicuous. There cannot be a doubt that this is the animal described by Montagu. We are happy, therefore, to have it in our power, before the close of this work, to give figures of a species hitherto involved in so much obscurity.

We lately obtained two specimens by the dredge in fifteen fathoms off St. Peter's Port, Guernsey, adhering to the base of an *Antennularia antennina*.

Figs. 1, 2. Back and side views of *Doto pinnatifida*.

3. One of the branchial papillæ, much enlarged.



### Fam. 3, Plate 45 (supplementary).

*Figs. 4 and 5.*

#### EOLIS PUSTULATA, ALDER and HANCOCK.

*E. alba*, pellucida; branchiis elongatis, linearibus, obtusis, aurantiacis, albo pustulatis, in seriebus 9-10 digestis; tentaculis breviusculis; angulis anterioribus pedis rotundatis.

*Hab.* From deep-water, Cullercoats, *J. A.*

*Body* a quarter of an inch long, rather slender, white, very transparent. *Dorsal tentacles* rather short, linear, smooth, somewhat obtuse, and blotched with opaque white at the apex. *Oral tentacles* scarcely so long as the dorsal pair, tipped with opaque white. From the transparency of the skin, the large corneous jaws appear between the oral and dorsal tentacles in the shape of two oblong brown patches united in front. *Branchiæ* rather long, linear, obtusely rounded at the apex; the central gland is of a yellowish-orange colour, and the surface is covered with minute opaque white pustules or granules, which appear to be imbedded in the skin: these are only visible with a lens. The front of the papillæ is also marked with irregular linear blotches of opaque white. They are disposed in nine or ten close-set rows of five or six each, not diminishing posteriorly in the usual manner: the papillæ of the last row extend considerably beyond the tail. *Foot* nearly linear, with the anterior angles rounded and the tail very little produced.

We obtained two individuals of this curious *Eolis* on some small corallines brought in by the fishing boats at Cullercoats, in the autumn of 1853. The granular character of the papillæ distinguishes it from any other British species. These organs are capable of great extension, and the animal has the power of bending them at right angles. They are usually held in a curved direction, inclining backwards and upwards. They exude a great quantity of mucus, and are covered with very long vibratile cilia. Probably the pustules giving the peculiar granular appearance to the papillæ may be mucus-cells.

Fig. 4. *Eolis pustulata*, side view.

5. Two of the branchial papillæ, much enlarged.

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Plate 45 also contains the following figures of Parasites.

Fig. 6. Back view of a parasite from *Doris pilosa*, supposed female.

7. Under side of the same.

8. Back view of a parasite from *D. pilosa*, supposed male.

9. Under side of the head of the same.

10. Dorsal view of a parasite from *D. tuberculata*.







## Plate 46. Supplementary.

### TONGUES OF THE DORIDIDÆ AND TRITONIADÆ.

The figures represent a single row of spines in each tongue; or, in the broad tongues, half, or such other portion of a row as is necessary to show the varying character of the spines. Our space would not allow us to figure all the tongues of which we have made drawings: we have, however, given the more striking and typical forms, and descriptions of the others will be inserted, with a comparative reference to those that are figured. Of the species omitted in the descriptions the tongues have not been examined.

The number of rows of spines increases with age, so that the numbers given in the descriptions can, in most cases, only be considered as an approximation. Care has been taken, however, where it was possible, to make the calculation from full-grown specimens.

#### Fam. DORIDIDÆ.

##### Sub-Fam. *Doridinæ*.

##### \* *Tongue broad.*

- Doris tuberculata*. Lateral spines numerous, 70 to 72 on each side, decreasing towards the centre, stout, smooth, strongly hooked. No central spine. 40 to 43 rows. 72·0·72. Fig. 1; and Fam. 1, Pl. 1, figs. 6, 7, 8, 9.
- D. flammea*. Lateral spines 35 or 36 on each side, similar in form to the last. No central spine. 25 rows. 36·0·36.
- D. Zetlandica*. Lateral spines numerous, long and slender, subclavate, minutely denticulated on the inner margin; decreasing abruptly towards the centre. No central spine. (The exact number of rows, or of spines in a row, could not be made out.) Fig. 2. *a*, a spine enlarged; *b*, portion of the same more enlarged.
- D. millegrana*. Lateral spines about 50 on each side, gradually decreasing towards the centre, stout, smooth, strongly hooked; 5 or 6 of the extreme laterals small, slightly bifid, and minutely denticulated. No central spine. About 32 rows; dark amber-coloured. 50·0·50. Fig. 3.
- D. Johnstoni*. Lateral spines about 25 on each side, stoutish, hooked, smooth; 5 of the extreme laterals slender, diminishing outwards, set at a different angle from the others. No central spine. 24 rows; pale straw coloured. 25·0·25. Fig. 4.
- D. planata*. Lateral spines about 30 on each side, long, stoutish, slightly hooked, smooth, diminishing gradually towards the centre; 9 or 10 of the extreme laterals smaller, very slender, arched, diminishing outwards. No central spine. (Number of rows not made out.) Colour pale yellowish-brown. 30·0·30. Fig. 5.

## DORIDIDÆ.

- D. coccinea*. Lateral spines numerous, about 60 on each side; those near the centre very short, broad, bicuspid, hooked; increasing suddenly into very long, slender, bifid, arched spines towards the sides. No central spine. About 65 rows; pale yellowish. 60·0-60. Fig. 6. *a*, an outside spine much enlarged; *b*, an inside spine much enlarged.
- D. repanda*. Lateral spines about 22 on each side, more or less curved; those next the centre stout, denticulated on each side; the outside ones longer and more slender, also strongly denticulated on the margin. A triangular central spine, the apex obtuse and curved, with 4 denticles. 68 rows. 22·1-22. Fig. 7; and Fam. 1, Pl. 1, figs. 10, 11.
- \*\* *Tongue narrow*.
- D. aspera*. Lateral spines 3 on each side; the inner one large and broad, having the anterior margin convex, the apex curved, with a ridge and a denticle on each side; outer spines rudimentary. A thin central plate, thickened at the margins, oblong-quadrate. 30 rows; transparent yellow. 3·1-3.
- D. proxima*. Lateral spines 1 and 10 small plates on each side; the spine large, falcate, with the angle thickened and ridged; plates subquadrilateral, slightly notched behind. No central plate. 41 rows. 11·1-11. Fig. 8.
- D. muricata*. Lateral spines 3 on each side; 2 rudimentary, and 1 large and broad, like that of *D. diaphana*, but rather broader at the base. Central plate narrower than in *D. diaphana*. 30 rows; pale brownish yellow. 3·1-3.
- D. diaphana*. Lateral spines 3 on each side; the 2 outer ones small and rudimentary; the inner large, thickened and convex on the inner margin, the apex curved, with a subdenticulated ridge, and an obtuse denticle on each side. Central plate oblong-quadrate. 30 rows; yellowish. 3·1-3. Fig. 9.
- D. oblonga*. Lateral spines 2 on each side; the inner one large, triangular, slender and a good deal curved above, broad at the base, the inner margin thickened and divided by constrictions into 3 portions, the upper one ridged or faintly denticulated at the sides; the outer spine smallish and obtusely hooked. No central plate. Tongue rather short. Pale yellowish. (The number of rows of spines not made out.) 2·0-2. Fig. 10.
- D. bilamellata*. Lateral spines 2 on each side; the inner one very large, triangular, tapering, smooth, slightly curved and rather slender above, broad at the base; outer spine small, obtuse. In the place of the central plate is an erect, ear-shaped, membranous fold. 28 rows. 2·0-2. Fig. 11.
- D. depressa*. Lateral spines 2 on each side; the inner one large, transversely elongated, subquadrate, with a fold on the inner margin and a small hook at the exterior and upper angle, the sides ridged and bearing an obtuse denticle; the outer spine small, broad. No central plate. 33 rows; almost colourless. Tongue comparatively small. 2·0-2. Fig. 12.
- D. inconspicua*. Lateral spines 2 on each side; the inner one transversely elongated, quadrate, with a fold on the inner margin, rather narrower than the last; the apex more produced, stout, hooked, with the sides minutely denticulated, and bearing a large obtuse process; outer spine inconspicuous. No central plate. 37 rows; yellowish, almost colourless. Tongue minute. 2·0-2. Fig. 13.
- D. pusilla*. Lateral spines 2 on each side; the inner one large, ovate-triangular, rather strongly hooked, with a denticulated ridge on each side, terminating in a strong tubercle; outer spine small. No central plate. About 30 rows. 2·0-2.
- D. sparsa*. Lateral spines 2 on each side; the inner one large, ovate-quadrate, like that of *D. inconspicua*, but shorter and less transversely elongated. No central plate. About 30 rows; almost colourless. 2·0-2.

## DORIDIDÆ.

- D. pilosa*. Lateral spines 4 on each side; the 3 outer ones small and rudimentary; the inner one large, broad and convex at the base, with a lateral thickened arch; the apex much produced, strongly curved, with a denticulated ridge on each side. No central plate. 27 rows. 4·0·4. Fam. 1, Pl. 1, figs. 3, 4, 5.
- D. subquadrata*. Lateral plates 5 on each side; the 4 outer ones rudimentary; the inner one large, very broad at the base, swelling anteriorly, with a lateral thickened arch; the apex elongated and curved, with a denticulated ridge on each side. No central plate. 20 rows; pale yellowish. 5·0·5. Fig. 14.

### Sub-Fam. *Polycerinae*.

- Goniodoris nodosa*. Lateral spines 1 and a small external plate on each side; spine large, sub-triangular, pointed, the upper part strongly denticulated at the sides. No central plate. 22 rows; dark amber-coloured.  $1+1\cdot0\cdot1+1$ . Fig. 15.
- G. castanea*. Like the last, but with the large spines smooth at the margin.  $1+1\cdot0\cdot1+1$ .
- Triopa claviger*. Lateral spines 2 and 10 plates on each side; the outer spine stout, hooked, and bifid, with the margin ridged; the inner very slender and curved; the plates quadrilateral. No central plate. 45 rows.  $10+2\cdot0\cdot2+10$ . Fig. 16.
- Ægirus punctilucens*. Lateral spines 19 or 20 on each side, uniform, rather stout, smooth, hooked. No central plate. 19 rows; amber-coloured. Tongue broad. 20·0·20. Fig. 17.
- Thecacera pennigera*. Lateral spines 2 and 3 plates on each side; spines rather slender, bicuspid, with the margin ridged; the inner spine smallest; plates quadrate-ovate, the outer one minute. No central plate. 10 rows; pale straw-coloured. Tongue rather small.  $3+2\cdot0\cdot2+3$ . Fam. 1, Pl. 21 a, fig. 7.
- T. virescens*. Lateral spines 2 and 5 plates on each side; spines stout, broad, bicuspid, ridged at the margin, the inner spine smallest; plates subquadrate. No central plate. 18 or 19 rows, alternate; pale yellow.  $5+2\cdot0\cdot2+5$ . Fig. 18.
- T. capitata*. Lateral spines 2 and 4 plates on each side; spines elongated, more slender than in *T. virescens*, bicuspid, the anterior point longest, margin ridged; plates oblong-ovate, pointed below, with a ridge in the centre. No central plate. 10 rows, alternate; dark amber-coloured.  $4+2\cdot0\cdot2+4$ . Fig. 19.
- Polycera quadrilineata*. Lateral spines 2 and 4 plates on each side; spines bicuspid, the anterior point produced into a strong, broad hook, with the margin ridged; inner plate smaller and less hooked; plates subovate, slightly angled, and elevated in the centre. No central plate. 15 rows, alternate; dark amber-coloured.  $4+2\cdot0\cdot2+4$ . Fig. 20.
- P. ocellata*. Lateral spines 2 and 5 plates on each side; spines bicuspid, stout, the points nearly equal in length; outer spine ridged at the sides, inner one very small; plates subquadrate-ovate. No central plate. 16 rows, alternate; rusty red-coloured.  $5+2\cdot0\cdot2+5$ . Fig. 21.
- P. Lessonii*. Like the last, but with 6 plates on each side and the spines rather more elongated. 13 rows; amber-coloured.  $6+2\cdot0\cdot2+6$ .
- Ancula cristata*. Lateral spines 2 on each side; the outer small, smooth; the inner large, broad, ovate, pointed, denticulated on the inner margin. No central plate. 25 to 27 rows; dark brown. 2·0·2. Fig. 22.
- Idalia elegans*. Lateral spines 2 on each side; the inner one large, falcate, broad at the base, tapering to a point above, the front margin thickened by a smooth rib; outer spine small, triangular. No central plate. 28 rows; pale yellow. 2·0·2.

## TRITONIADÆ.

- I. Leachii*. Lateral spines 2 on each side; the inner one large, falcate, the base broader and rather more slender than in *I. elegans*, the apex curved and pointed, the margin thickened by a minutely denticulated rib; outer spine small, ovate triangular, slightly hooked. No central plate. 29 rows; brownish amber. 2·0·2. Fig. 23.
- I. aspersa*. Lateral spines 2 on each side; the inner one large, much hooked, recurved, and strongly denticulated at the sides, the base broad and incurved; outer spine rather small, smooth, hooked. No central plate. 21 rows; amber-coloured. 2·0·2. Fig. 24.
- I. inæqualis*. Like the last, but with the bases of the spines longer and much produced diagonally. 31 rows, dark amber-coloured, 2·0·2.
- I. pulchella*. Like *I. inæqualis*, but with the bases of the inner spines more elongated, and the outer spines stouter. 25 or 26 rows; amber-coloured. 2·0·2.

## Fam. TRITONIADÆ.

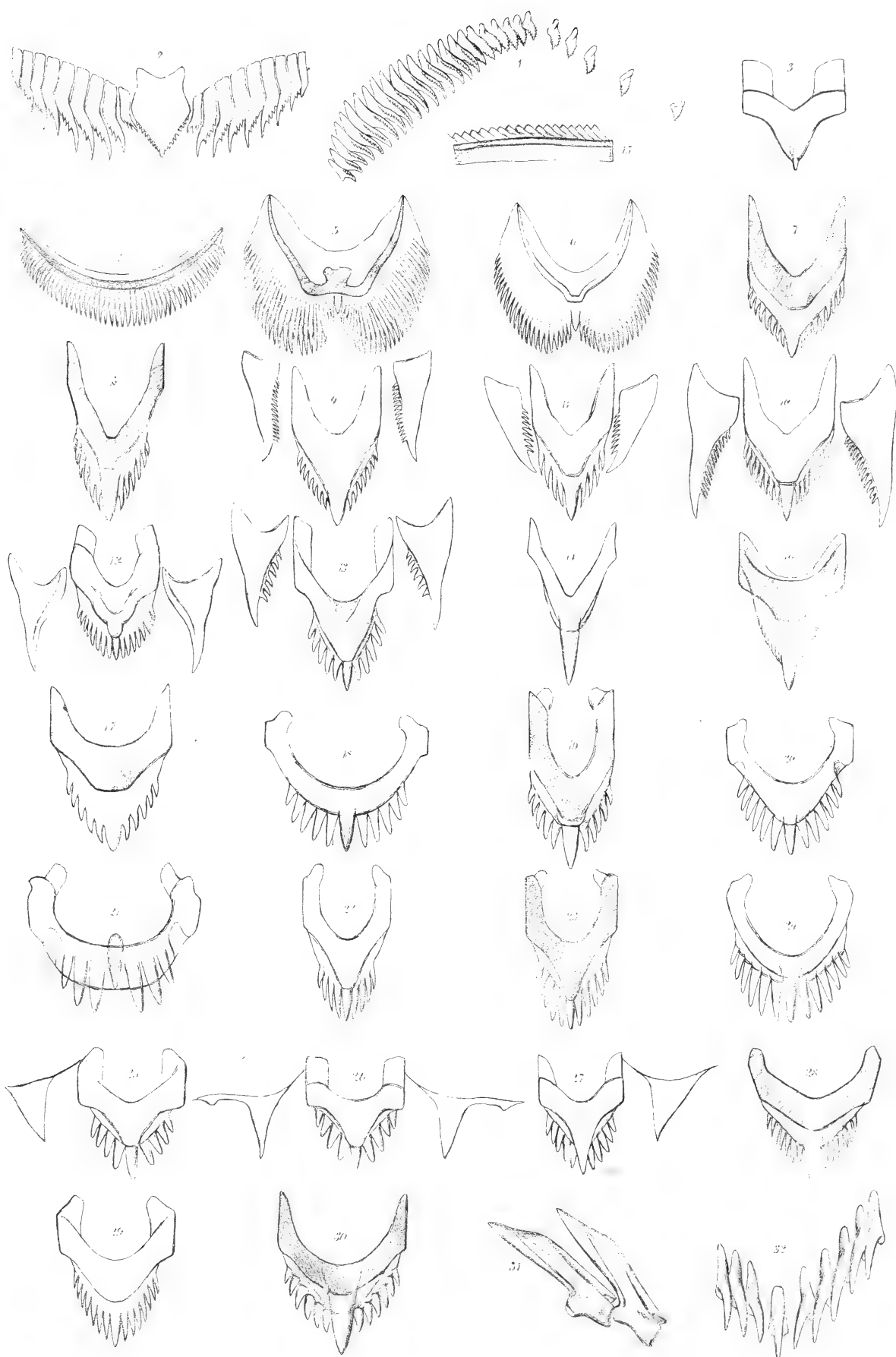
- Tritonia Hombergii*. Lateral spines very numerous, about 220 on each side, curved, smooth, stout towards the centre of the tongue, becoming slender at the sides. Central plate broad, obscurely tricuspid, blunt; sublateral plates ovate-quadrangle, one on each side of the centre. 84 rows. Tongue very broad.  $220 \cdot 1 + 1 + 1 \cdot 220$ . Fam. 2, Pl. 1, figs. 4, 5, 6.
- T. alba*. Lateral spines 36 on each side, very slender, curved, with 2 or 3 long, slender, marginal denticles. Central plate tricuspid, the middle point longest; sublateral plates subovate-incurved, and pointed. 29 rows. Central plate yellow; spines colourless.  $36 \cdot 1 + 1 + 1 \cdot 36$ . Fig. 26.
- T. plebeia*. Lateral spines 21 on each side, smooth, more slender, broader at the base, more hooked at the point, and set further apart than in *T. Hombergii*. Central plate distinctly tricuspid; sublateral plates subovate-angulate.\* 45 rows; pale yellow, nearly colourless.  $21 \cdot 1 + 1 + 1 \cdot 21$ . Fig. 25.
- Scyllæa pelagica*. Lateral spines about 35 on each side, elongated, with a strong tooth at the apex, and 3 or 4 lateral denticles. Central plate subquadrangle, produced into a strong tooth at the apex, with 5 denticles on each side. 13 rows, set diagonally backwards; brownish amber-coloured.  $35 \cdot 1 \cdot 35$ . Fig. 27, and Fam. 2, Pl. 5, fig. 3.

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\* The sublateral plates are very similar in all the three species; whether they appear subovate-angulate or subovate-incurved, depends upon the way in which they happen to be seen.







## Plate 47. Supplementary.

### TONGUES OF THE EOLIDIDÆ.

#### Sub-Fam. *Dendronotinae*.

*Lomanotus* (*Genei*, Ver.) Tongue broad. Lateral spines numerous, 28 to 32 on each side, falcate, broad at the base, denticulated on both edges; the spines diminish gradually towards the centre, where they are set wide apart; they also diminish abruptly towards the outside. No central plate. 28 rows; brown amber-coloured. 32·0-32. Fig. 1. The spines of *L. marmoratus*, represented Fam. 2, Pl. 5, fig. 12, are of the same character as these, but less numerous. We have been obliged, in this instance, to take our example from a foreign species, the arrangement being imperfectly made out in *L. marmoratus*, in consequence of the state of the specimen.

*L. flavidus*. Tongue and spines similar to those of the above species. The number of rows and of spines in each row were not made out. Pale yellow.

*Dendronotus arborescens*. Tongue rather narrow. Lateral spines 8 or 9 on each side, sublinear, bent backwards in the middle, and terminating in a fine point; the outer edge denticulated; they increase gradually towards the centre, excepting the last, which is small and truncated. Central spine large, broad, spatulate, denticulated on each side; it is amber-coloured; the lateral spines nearly colourless. 40 rows. 9·1-9. Fig. 2; and Fam. 3, Pl. 2, figs. 6, 7, 8.

#### Sub-Fam. *Melibinae*.

*Doto fragilis*. Tongue very small and narrow, consisting of a single central plate, pointed at the apex and arched at the base; the sides plain or subdenticulated. Above 100 rows. 0·1·0. Fig. 3; and Fam. 3, Pl. 4, figs. 4, 5, 6.

*D. coronata*. Like *D. fragilis*, but rather more distinctly denticulated at the sides. Above 100 rows. 0·1·0.

#### Sub-Fam. *Eolidinae*.

*Tongue narrow, generally a central plate only.*

*E. papilosa*. Lingual plate broad, forming a single arch, bearing numerous uniform denticles (about 46); base of plate with an amber-brown band. Upwards of 30 rows. 0·1·0. Fig. 4; and Fam. 3, Pl. 7, figs. 5, 6, 7.

*E. glauca*. Lingual plate rather broad, forming a double arch, with numerous denticles (averaging about 33 on each side, with a short, stout one in the centre); the lower portion of the plate yellowish, with a dark, purple-brown band above. 21 plates. Tongue tapering gradually towards the front. 0·1·0. Fig. 5.

## EOLIDIDÆ.

- E. Alderi.* Like the last, with the denticles a little more slender (averaging 23 on each side); the base pale yellow, with the boundary line a little darker. 13 plates. Tongue tapering gradually. 0.1.0. Fig. 6.
- E. coronata.* Lingual plate arched, rising into a strong spine in the centre, with 7 or 8 denticles on each side. Upwards of 15 plates; amber-coloured. Tongue tapering. 0.1.0. Fig. 7.
- E. Drummondi.* Like the last, but having the plates more pointed, with 9 denticles on each side. 16 plates; brown amber-coloured. 0.1.0.
- E. elegans.* Lingual plate slender, deeply arched and pointed, tapering to a very strong spine in the centre, with 6 denticles on each side. About 20 plates; pale yellow. 0.1.0. Fig. 8.
- E. rufibranchialis.* Central plate tapering to a strong, rather obtuse point, with 7 denticles on each side; a separate, slender lateral spine on each side, of an acute triangular form, with the apex turned outwards, and having on the inner margin 12 or 14 minute denticles. 15 to 20 rows; amber-coloured. 1.1.1. Fig. 9.
- E. lineata.* Like the last, but with the lateral spines considerably larger and broader, with the apex curved inwards; the inner margin with 13 denticles. 14 rows; pale yellow. 1.1.1. Fig. 10.
- E. smaragdina.* Like *E. rufibranchialis*, but with the central plate broader, more squared at the sides, and the denticles stouter; the lateral spines more triangular, shorter, the apex curved inwards, and with only 6 denticles. About 13 rows; colourless. 1.1.1.
- E. gracilis.* Like the last, but with the denticles of the central plate longer, stouter, and only 4 in number; denticles of the lateral spines 8. About 13 rows; pale straw-coloured. 1.1.1. Fig. 11.
- E. pellucida.* Lingual plate uniformly arched, pretty evenly denticulated, with 15 denticles, the centre one not much larger than the rest; lateral spines 1 on each side, smooth, pointed, broad at the base. 26 or 27 rows. 1.1.1. Fig. 12.
- E. Landsburgii.* Central plate a pointed arch, with the marginal denticles straight, rather stout, nearly as large as the central one, 5 on each side; lateral spines 1 on each side, rather large, with 5 or 6 denticles on the inner margin, and the apex much produced. 27 rows; pale yellow. Tongue tapering slightly. 1.1.1. Fig. 13.
- E. alba.* Lingual plate a slender, pointed arch, smooth at the sides, with a large, smooth central spine; no lateral spines. 11 or 12 plates; pale yellow. 0.1.0. Fig. 14; and Fam. 3, Pl. 7, figs. 11, 12.
- E. carnea.* Like the last, with the spine a little more slender. 0.1.0.
- E. glaucoides.* Tongue very slender and minute, with apparently a single, smooth central spine. Upwards of 50 rows, closely united, and appearing like one continuous band. (We have only been able to see this tongue in profile, as represented in the figure.) 0.1.0. Fig. 15.
- E. Peachii.* Lingual plate a pointed arch, with a broad, angulated base, the apex rising into a strong spine, with 9 or 10 small lateral denticles. 18 plates; dark amber-coloured. Tongue tapering. 0.1.0. Fig. 16.
- E. nana.* Lingual plate a broad arch, with a thick, obtuse central spine, and 5 curved denticles on each side. 21 plates; dark amber-coloured. Tongue tapering. 0.1.0. Fig. 17; and Fam. 3, Pl. 7, figs. 9, 10.
- E. stipata.* Lingual plate a broad, slender arch, with 11 strong, straight denticles, the central one scarcely exceeding the others in size. 69 plates; pale yellow. Tongue not tapering. 0.1.0. Fig. 18.
- E. concinna.* Lingual plate a pointed arch, straight at the sides, and tapering to a strong central spine; lateral denticles 5 on each side, rather stout, curved, and not so long as the central spine. 29 plates; brown amber-coloured. Tongue tapering very little. 0.1.0. Fig. 19.

## EOLIDIDÆ.

- E. olivacea*. Lingual plate a widish arch, with 13 strong, rather diverging, slightly curved denticles, the central one scarcely stronger than the rest. 57 plates; pale yellow. Tongue tapering a little. 0·1·0. Fig. 20; and Fam. 3, Pl. 7, fig. 8.
- E. aurantiaca*. Lingual plate a broad arch, with 6 strong, straight, rather distant denticles or spines. Upwards of 80 plates; almost colourless. Tongue tapering very much. 0·1·0. Fig. 21.
- E. pustulata*. Lingual plate a slender, subangular arch, straight at the sides, with 9 large denticles; the central one stouter, but scarcely more prominent than the rest. About 23 plates. 0·1·0. Fig. 22.
- E. amæna*. Like the last, with the denticles less curved, 11 in number. 20 plates. Tongue tapering very little. 0·1·0. Fig. 23.
- E. Glottensis*. Lingual plate a broad, rounded arch, with 11 strong, straight denticles, the central one not much larger than the rest. 54 plates; pale yellow. Tongue tapering very little. 0·1·0.
- E. viridis*. Like the last, with the lingual arch more slender, and the denticles rather larger, 5 or 6 on each side. 36 plates; pale yellow. Tongue tapering very slightly. 0·1·0. Fig. 24.
- E. vittata*. Central plate rather broad and angulated, with the apical spine prominent, and 3 or 4 straight, largish, diverging denticles on each side; a separate, plain, triangular spine on each side. 67 rows; pale straw-coloured. 1·1·1. Fig. 25.
- E. exigua*. Like the last, but with the central plate and lateral spines rather narrower. 40 plates; pale yellow. Tongue tapering to a fine point. 1·1·1.
- E. tricolor*. Central plate angulated, rising to an obtuse spine at the apex, the marginal denticles very stout, 4 on each side; the 2 lateral spines slender, smooth. About 70 plates; pale straw-coloured. 1·1·1. Fig. 26.
- E. amethystina*. Like the last, but with the denticles rather longer, and not quite so stout. 62 plates; pale yellow. Tongue tapering very slightly. 1·1·1.
- E. Farrani*. Like *E. tricolor*, but with the denticles more slender, 5 on each side; the lateral spines larger and broader. 1·1·1. Fig. 27.
- E. picta*. Like *E. tricolor*, but with the central plate more slender and pointed, the apex more prominent, and the denticles longer, and more slender, 4 on each side. Lateral spines small. (Number of rows not determined.) Pale straw-coloured. 1·1·1.
- E. despecta*. Lingual plate rather broad, with a strong apical spine, and 6 delicate, short, curved denticles on each side; no lateral spine. 22 plates; amber-coloured. Tongue tapering conspicuously. 0·1·0. Fig. 28.
- Embletonia pulchra*. Lingual plate narrow, arched at the sides and produced into a prominent point in the centre, with small lateral denticles.\* 60 plates. 0·1·0. Fam. 3, Pl. 38, figs. 5, 6.
- E. pallida*. Lingual plate evenly arched, broad at the base, with the central denticle or spine slightly prominent, and 6 or 7 well-defined, rather slender, curved denticles on each side. 31 plates; almost colourless. Tongue tapering gradually. 0·1·0. Fig. 29.

### Sub-Fam. *Hermæinæ*.

- Fiona nobilis*. Lingual plate a broad arch, with a strong, prominent, central spine, and 6 stout, strongly curved denticles on each side. 33 to 40 plates; orange or amber-brown. Tongue tapering slightly. 0·1·0. Fig. 30; and Fam. 3, Pl. 38*a*, fig. 7.

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\* These have not been represented on the figure; the magnifying power used at the time being insufficient to show them.

## EOLIDIDÆ.

*Hermæa bifida*. Lingual plate with a cylindrical articulated base, and a large scooped spine or process, terminating in a blunt point. 49 rows; pale yellow. Tongue tapering to a point anteriorly. 0·1·0. Fig. 31.

*H. dendritica*. Like the last, but with the articulations rather shorter and the process more squared at the top. 40 to 45 rows. 0·1·0. Fam. 3, Pl. 43, figs. 14, 15.

*Alderia modesta*. Lingual plate cylindrical (?), rather long, bearing a scoop or spine, broad and truncated at the upper end. 16 or 17 rows. Tongue linear, not tapering. 0·1·0. Fam. 3, Pl. 43, figs. 17, 18.

### Sub-Fam. *Proctonotina*.

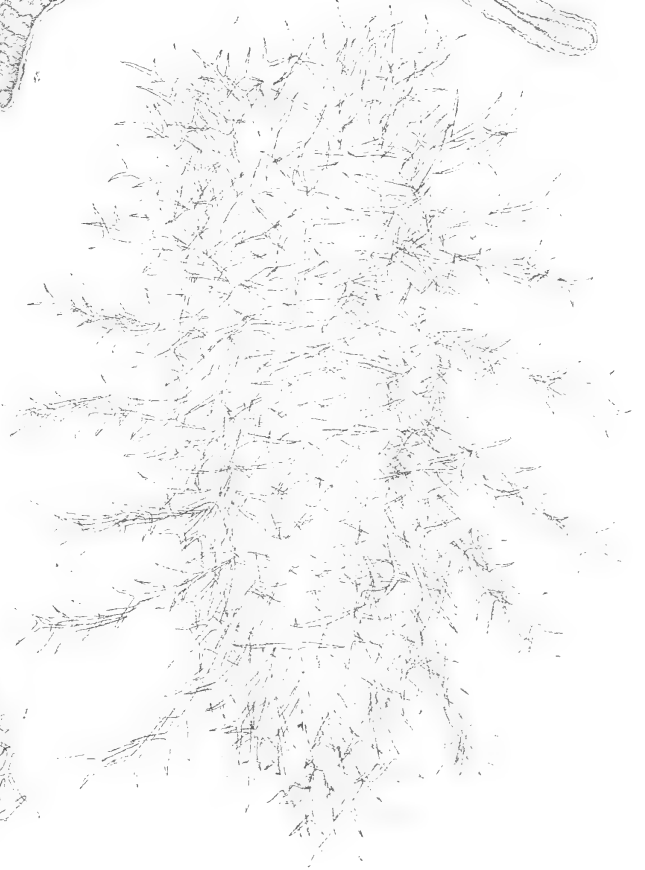
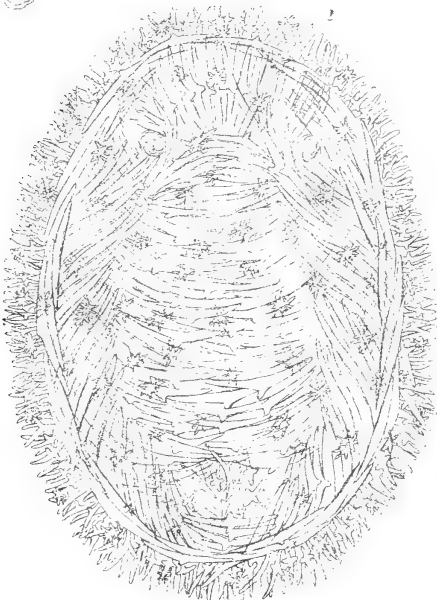
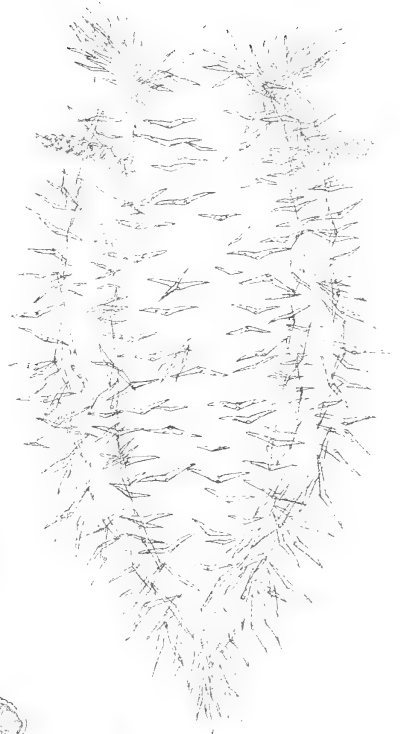
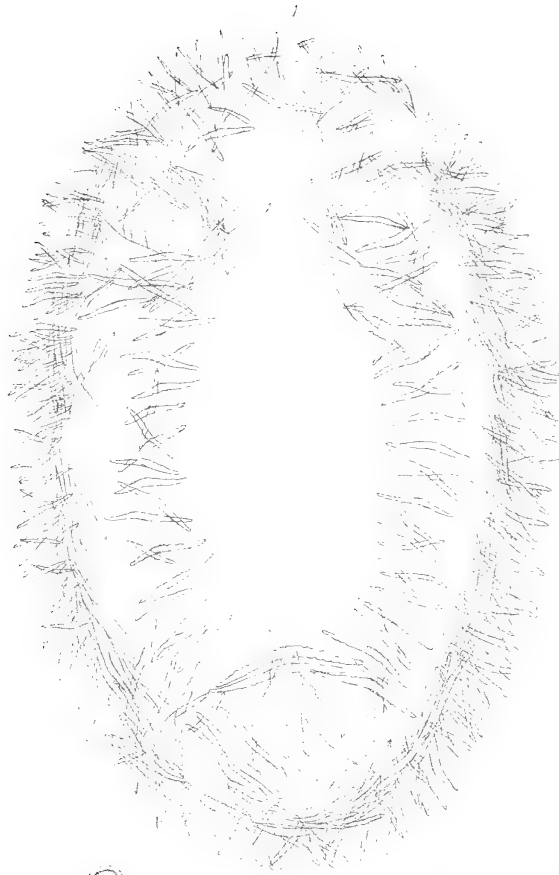
#### *Tongue broad.*

*Proctonotus mucroniferus*. Lateral spines numerous, plain, simply hooked; central spine inconspicuous or wanting. (The details in this species have been imperfectly made out.) Fam. 3, Pl. 43, fig. 12.

*Antiope cristata*. Lateral spines numerous, about 40 on each side, plain, slightly hooked and sharply pointed. Central spine not much smaller than the rest. 30 rows, sloping diagonally forward; deep amber-coloured, approaching purple-brown. 40·1·40. Fig. 32; and Fam. 3, Pl. 43, figs. 5, 6, 7.

*A. hyalina*. Lateral spines 12 or 13 on each side, rather stout, plain, moderately hooked. Central spine small, plain. 10 or 12 rows, sloping a little backwards; almost colourless. 13·1·13.







## Plate 48. Supplementary.

### SPICULA OF THE DORIDIDÆ.

The various forms of the spicula of the *Dorididæ* have been represented, as far as possible, in the plates appropriated to the several species, and in one or two instances the mode of their arrangement has been described. The more completely to illustrate the latter character, however, which can be only very imperfectly conveyed in a description, we have thought it desirable to devote a plate to the representation of the arrangement of the spicula in one or two of the most characteristic species.

The spicula vary very much in size, and often also in form, in one and the same animal. As a general rule, they may be considered to consist of two sizes, a larger and a smaller, though there are often intermediate gradations. Their form is generally linear, varying to triradiate and cruciform, and bent in various ways. In the *Doridinæ* they are usually plain and pointed, but in the *Polycerinae* they are more or less nodulous and obtuse. In the latter sub-family they are always few in number, and, in some of the species, small and irregularly scattered. Most of the *Dorides*, on the contrary, have them very numerous and closely packed over the whole surface; this is more decidedly the case in the second section of the genus, represented in the plate by *Doris aspera*. The small species of that section, of which we have not been able to get a good example for figuring, show the symmetrical arrangement more distinctly, on account of the large size of the spicula. These are, however, less numerous, but in other respects the same.

The spicula are found in all parts of the skin, including the tentacles and branchial plumes, but are most numerous in the cloak, and especially toward the margin. There are few in the foot. In the cloak, they usually lie transversely across the middle of the back, and diagonally at the sides; the margins are thickened with numerous spicula, frequently of smaller size, disposed in a radiating manner. These last are bound together by others lying parallel to the margin all round. The small spicula of the tentacles are in some species, as in *Goniodoris nodosa*, curiously curved into a semicircle, accommodating themselves to the form of those organs, in which they lie transversely.

It is in the dermal layer or cutis that the spicula are imbedded. They are developed within delicate membranous cells, which are of the form and size of the spicula. In *Thecacera pennigera*, in which species we have more especially studied their development, there are two centres of growth,—one towards each extremity. At first a few granules of calcareous matter mark the foci; afterwards they consolidate, and, increasing in size, form two nodules, each with a projection from the inner limb: these projections gradually elongate,

## SPICULA OF THE DORIDIDÆ.

and ultimately become united, the result being a slender spiculum with large rounded extremities. The spiculum then goes on thickening until it completely fills the vesicle, and puts on the mature nodulous appearance. Afterwards the vesicle becomes indistinct, or perhaps entirely disappears.

Fig. 1. Spicula as arranged in *Doris pilosa*.

2.           "           "       *Doris aspera*.

3.           "           "       *Goniodoris nodosa*.

4.           "           "       dorsal tentacles of ditto.

5.           "           "       *Triopa claviger*.

6, 7, 8, 9, 10, 11. Spicula of *Thecacera pennigera* in various stages of growth :  
a, vesicle ; b, spiculum.

## APPENDIX.

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### (1) DORIS ZETLANDICA.

Mr. Barlee obtained a specimen of this new Doris in Shetland in the summer of 1849. It differs from all the other British species with retractile branchiæ in the form of the tubercles. The dorsal tentacles are finely laminated, the laminae nearly uniting in front. The oral tentacles tubercular. The most remarkable difference, however, is in the character of the tongue, which in this species is covered with long, slender, linear, subclavate spines, denticulated on the inner margin. We are indebted to Mr. Jeffreys, of Swansea, for the opportunity of dissecting the specimen, which we had previously examined and sketched through the kindness of Mr. Barlee. This gentleman announced it, with his other discoveries in Shetland, to the British Association Meeting at Birmingham in 1849.

### (2) DORIS MILLEGRANA.

Two specimens of this Doris, which we do not find before described, are preserved in Dr. Leach's Collection in the British Museum. They are in the same bottle with a specimen of *Doris tuberculata* (*Britannica*, Leach), with which they appear to have been confounded. The label indicates that they were sent from Torbay by Mrs. Griffiths. In spirits they are of a dull yellow colour, with one or two small purplish blotches near the margin of the cloak in one of the specimens. The cloak extends considerably beyond the foot, and is smooth on the under side; above it is covered with minute, close-set granular tubercles, very little raised above the surface, and of nearly equal size, having a few smaller ones interspersed. The dorsal tentacles are retracted in both specimens, but may be seen to taper gradually to a point above; the apertures have a thin, undulating edge. The oral tentacles are linear. There are six bipinnate branchial plumes, retractile within a cavity, with a nearly smooth margin. The foot is transversely slit in front, with the upper lamina strongly notched in the centre.

This species comes nearest to *D. Johnstoni*, but is at once distinguished by having only six plumes, which are arranged as in *D. tuberculata*, and do not form a cup as in the former species. The tubercles, too, are much shorter than those of *D. Johnstoni*, a little larger, and not quite so closely set, giving the surface a delicate granular appearance. The tongue resembles a good deal that of *D. tuberculata*; the spines are of a similar character, smooth and

rather stout; but in this species five or six of the extreme lateral spines are minutely pectinated, which is not the case in *D. tuberculata*, nor in *D. Johnstoni*, though in the latter the spines are also of two kinds.

(3) *DORIS REPANDA*.

*Doris lævis*, Flem., Brit. Anim., p. 282.

*obvelata*, Lovén, Ind. Moll. Scand., p. 4.

We have been favoured by Dr. Fleming with the examination of an original specimen of his *D. lævis* preserved in spirits, from which we can say with certainty that it is synonymous with our *D. repanda*. The *D. lævis* of Müller is a very distinct species, of which we have also had the opportunity of examining a specimen, by the favour of Dr. Lovén. The latter species has not yet been found in Britain, though it is not improbable that it may inhabit our Northern shores. Dr. Lovén considers that our *D. repanda* is the *D. obvelata* of Müller, which may possibly be the case, but his description and figure are not sufficiently accurate to enable us to determine this. His figure represents the tubercles larger than in our species, and the cloak differently coloured, and it wants the characteristic opaque white or sulphur-coloured spots along the sides.

(4) *DORIS MURICATA*.

Mr. Thompson, of Belfast, records the discovery of this species in Ireland, in the 'Annals of Natural History,' v. 5, p. 86. He there says,—“I have not unfrequently taken this minute species when (accompanied by Mr. Hyndman) dredging in the Loughs of Strangford and Belfast; it was generally adhering to the leaves of tangle (*Laminaria digitata*). Müller describes it as 5 lines long by 3 broad: my specimens were all even under that size. The *D. muricata* has hitherto been unnoticed in the British seas.” Mr. Thompson afterwards kindly sent us specimens in spirits. In that state they resembled very much our *D. aspera*, but appeared to have the tubercles rather larger and the cloak a little more rounded. So much, however, depends upon the state of contraction and other circumstances, that it is difficult to give an opinion on critical points from spirit-specimens. The liver, as seen through the foot, appears much larger than in *D. aspera*, and in this respect comes nearer to *D. proxima*, but the tongue shows that it is more nearly related to the former than to the latter.

(5) *DORIS ULIDIANA*.

*Doris Ulidiana*, Thomp., in Ann. Nat. Hist., v. 15, p. 312.

“Length from spirits  $\frac{1}{2}$  inch, breadth  $\frac{1}{4}$  inch; ovate-oblong, rather straight at the sides, depressed, of a uniform pale yellow, the intestines appearing through the skin of a dark colour. Cloak not extending much beyond the foot, rough with spicula, and covered with large, unequal, obtuse tubercles; the spicula collected in bundles in the tubercles and radiating at their base. Tentacula long and whitish, lamellated, without sheaths; the edges of the apertures plain. Branchiæ consisting of eleven beautifully white pinnated plumes, set in a semicircle round the anus. Foot rather broad. Veil above the mouth semicircular.”

“On the 17th February, 1840, I procured three specimens of this *Doris* among oysters brought to Belfast Market from the neighbouring coast of Down or Antrim.” *W. Thompson.*

The above description, drawn up by ourselves from the specimens in spirits, with the addition of Mr. Thompson's notes from the living animal, was published in the ‘Annals of Natural History’ for May, 1845. The species comes very near to *D. diaphana*, from which it differs a little in colour, in being rather more elongated, in having a larger veil, and more especially in the size of the liver, that of *D. diaphana* being larger, blacker, and reaching further forward in the body than in this species. The mouth too is larger, and is almost in the centre of the veil.

(6) *DORIS PUSILLA.*

Mr. George Murray informs us that he has got two specimens of this *Doris* at Burghead, on the coast of Elgin.

(7) *DORIS SUBQUADRATA.*

A specimen of this rare species was got at Hilbre Island, Mouth of the Dee, in April, 1851, by Mr. I. Byerley, of Upton, Birkenhead.

(8) *ÆGIRUS PUNCTILUCENS.*

A young individual of this species has been got at Burghead, Elgin, by Mr. Murray; the only one yet found on the eastern coast of Britain.

(9) *THECACERA PENNIGERA.*

*Doris pennigera*, Mont., in Linn. Trans., v. 11, p. 17, pl. 4, fig. 5.

“Body oblong, acuminate almost to a point at the posterior extremity, covered with small spots of bright orange and black on all the upper parts; the black markings are smallest, and appear radiated under a lens: the anterior end is sub-bifid, extending each side into an angular lobe: tentacula two, sub-clavate and perfoliate; these originate on the upper part some distance from the anterior end, and each is nearly surrounded by a sort of bipartite wing; the vent is on the back, furnished with five branched appendages that partly surround it on the fore part, and two large bifid peduncles behind. Length half an inch.

“One specimen only of this singular and gaudy animal has occurred: it was taken at low-water on the rocks at Milton.” *Montagu, loc. cit.*

While these sheets are going through the press, and since the Synopsis was printed off, we have obtained a specimen of this interesting species, through the kindness of Mr. W. Thompson, of Weymouth, which has enabled us to give figures of it in an additional plate. (Fam. I, Plate 21 a.)

(10) *THECACERA VIRESCENS*.

*Thecacera virescens*, Ald. and Hanc., in Ann. Nat. Hist., 2d ser., v. 8, p. 290.

Body rather convex, smooth, and of a light peach-blossom tint, blotched with green anteriorly and posteriorly. Head with a plain margin in front. Tentacles broadly laminated; the laminated portion green, the lower or smooth portion of the same colour as the body: they are retractile within moderately sized sheaths, with smooth margins. Branchial plumes five, green, margined with white. A single row of obsolete tubercles encircles the branchial region. Foot of a dull yellowish-white. Length three tenths of an inch.

This description was drawn up from two individuals sent us in spirits by Mr. W. P. Cocks, of Falmouth, assisted by his notes and drawings of the animal in a living state. The specimens were found by Mr. Cocks, at low-water mark, on the oyster bed at Bar Point, Falmouth, in March, 1849.

(11) *THECACERA CAPITATA*.

A few specimens of this new *Thecacera* were dredged in twenty fathoms water off St. Ives, Cornwall, in September, 1853, by Mr. Barlee, who kindly presented two of them to us. The larger specimen was nearly colourless when it reached us (in spirits), but had the orange tubercles very distinct: there were four or five on each side of the veil, and a row of four between the tentacles; besides which there was a row of smaller tubercular orange spots on each side of the body below the veil; and a central and two lateral rows of obscure yellowish tubercles reached from the branchiæ to the tail. The veil was continued in a slight pallial ridge backwards, dying out before it reached the branchiæ. The smaller specimen was darker and more distinctly freckled, but the orange colour of the processes was gone. In this specimen only two tubercles were observed on each side of the veil.

The last two species differ considerably from the first, which must be taken as the type of the genus *Thecacera*, but the sheathed tentacles sufficiently unite them to allow of their being placed in the same genus.

(12) *IDALIA ASPERSA*.

*Idalia cirrigera*, 'Phil.,' Lovén, Ind. Moll. Scand., p. 5.

Professor Lovén, who considers that the number of filaments is variable and does not afford a specific character in this genus, has united our *I. aspersa* with the *I. cirrigera* of Philippi. In this he is certainly mistaken. We have recently had an opportunity of examining several specimens of this rare genus, and find the number of filaments in each species to be pretty constant: a slight variation undoubtedly occurs, but this is seldom of such importance as to leave any doubt of the species to which the individual belongs. The Scandinavian species, a drawing of which we have seen, appears to be a variety of our *I. aspersa*. In our description of this species we have stated the number of branchial plumes to be twelve: a more careful examination has satisfied us that the real number is only ten,

but, the anterior and posterior ones being bifid, there are twelve points, which without minute inspection may be taken for distinct plumes.

*Idalia aspersa* has been found at Bray, near Dublin, by Dr. Ball.

(13) *IDALIA INÆQUALIS*.

*Idalia inæqualis*, Forbes, Brit. Moll., v. 3, p. 579, pl. xx, fig. 4.

"Body oblong, flattened, but very thick, truncate in front, suddenly tapering, pointed behind. Back circumscribed, elevated, with steep sides. Dorsal tentacula linear, laminated; tentacular appendages set well apart, filiform, the anterior pair shortest, the lateral or posterior pair very long, longer than the tentacula immediately in front of which they are set. The animal when crawling usually carries its tentacles obliquely reflected, the anterior appendages curved upwards, and the long ones directed sideways and backwards. The branchiæ are from seven to nine in number, forming a complete and erect circle; on each side of them are five or six rather short, unequal filamentous processes, the anterior ones approximated. The general colour is grey, speckled with white, yellow, and brown. An opaque yellow line runs down the centre of the tail, with dots of the same colour on each side of it. The sides of the back are speckled with madder-brown and yellow. The branchial plumes are tipped with purplish-brown, and banded centrally with white. The length of the body is rather more than half an inch.

"Two examples of this beautiful sea-slug, nearly allied to the last (*I. aspersa*), but possessing distinct characters in the proportions and disposition of the tentacular and branchial appendages, were dredged in thirty-five fathoms water on a sandy bottom in St. Magnus' Bay, Zetland (M<sup>r</sup> Andrew and E. F.) When kept they appeared to be sluggish and very glutinous to the touch."

We have been favoured with an examination of these specimens in spirits. They come very near to our *I. aspersa*; the principal difference being in the disproportionate length of the anterior filaments, and in the number of branchial plumes. These latter are nine, the anterior one bifid. The posterior lateral filament on each side is also bifid.

(14) *IDALIA PULCHELLA*.

A single specimen of this little *Idalia* was obtained by Mr. Barlee, while dredging off St. Ives, Cornwall, in the summer of 1853, and was sent to us in spirits. Its chief characteristics are, the subclavate tentacles, laminated for three fourths of their length, the expansion of the pallial margin in front, and the great size of the bifid posterior filaments. Its colour is also somewhat different from that of the other species, being when alive, Mr. Barlee informs us, delicately freckled with a very light lilac colour. It was got among corallines in about twenty fathoms.

(15) *IDALIA QUADRICORNIS*.

*Doris quadricornis*, Mont., in Linn. Trans., v. 11, p. 17, pl. 4, fig. 4.

Flem., Brit. Anim., 283.

*Idalia quadricornis*, For. and Han., Brit. Moll., v. 3, p. 580.

"Body ovate, mottled brown and white; along each side an obsolete row of tubercles, somewhat dilatable, extending from the tentacula to the vent: tentacula four, long, both pairs originating from the upper part, and approximating; the anterior shortest, setiform, inclining forwards; the other filiform, reflecting backwards, the same colour as the body: vent situated near the extremity of the back, surrounded with eight or nine branched appendages. Length three eighths of an inch. Rare."

Montagu, whose short description we have inserted entire, is the only person who has met with this obscure species, which requires further illustration.

#### 16) TRITONIA ALBA.

We have occasionally obtained this new species at Cullercoats, in company with *T. plebeia*, on masses of *Alcyonium digitatum*, brought in on the fishermen's lines. In its characters it approaches so nearly to *T. Hombergii* that we were for some time inclined to consider it the young of that species; but as the individuals were always of small size, and no intermediate examples were found connecting it with the adult *T. Hombergii*, which is very rarely brought in on the fishing lines, and as the specimens found were constantly of a white colour, some doubt might be considered to rest upon their supposed identity. The point has been satisfactorily settled by an examination of the tongues of the two species. That of *T. Hombergii* is very broad, and has the lateral spines all simple; the tongue of *T. alba* is narrower, and has the spines, which are rather more slender than in the other species, branched or denticulated on the outer margin. This difference could not be the result of age. But to satisfy ourselves more fully upon this point, we have examined the tongue of the undoubted young of *T. Hombergii* of the same size as *T. alba*, got along with the adult in Torbay, and find that the spines have the same simple character as in the large specimens. There can be no doubt, therefore, of their distinctness. We have not had an opportunity of comparing them together, so as satisfactorily to define the points of difference in their external characters, but speaking from recollection, we should say that the new species is rather flatter and less tuberculated, the pallial ridge is more produced, the branchiæ shorter and less perfectly laminated, and that the veil has fewer digitations than in *T. Hombergii* of the same size. The whole animal is also more delicate and transparent.

#### (17) SCYLLÆA PELAGICA.

*Scyllæa pelagica*, Linn., Syst. Nat., 12th ed., v. 1, p. 1094.

Cuv., Ann. du Mus., v. 6, p. 416, pl. 61, figs. 1—7.

For. and Hanl., Brit. Moll., v. 3, p. 584, pl. AAA, fig. 5.

We are unfortunately unable to add anything to the short description of this species given in our Synopsis. A single specimen was sent to us in spirits by Mr. W. P. Cocks, of Falmouth, in April, 1847, being one of three which he found alive among a large mass of seaweed thrown up after a storm. They were attached to the frond of a weather-beaten *Laminaria bulbosa*, from deep water, thrown upon the rocks near Pendennis Castle. Mr. Cocks remarks that their appearance when alive was gelatinous, transparent, and of a light cream-colour without markings. He kept them for three days in sea-water, but being unwell



and unable to attend to them, was obliged to put them into spirits. We regret that we cannot give a drawing of this interesting addition to our Fauna in a living state. From its known pelagic habits, *Scyllæa pelagica* may perhaps be considered only an accidental visitant to our shores, but it is worthy of remark that these examples were not found upon the floating Gulf weed (*Sargassum bacciferum*), but upon one of our native algæ, common in deep water. There is a presumption, therefore, that the species may really be an inhabitant of our Atlantic shores.

† (18) LOMANOTUS, (λωμα, border, and νωτος, back.)

This genus, published by M. Verany in the '*Revue Zoologique*' in 1844, is synonymous with our *Eumenis*, which did not appear until the following year. M. Verany's name consequently has the precedence and must be adopted.

(19) EOLIS GLAUCA.

Mr. Cocks has taken several examples of this fine species at Falmouth. We also got a single individual while dredging near the entrance of the Menai Straits, off Beaumaris.

(20) EOLIS CORONATA.

? *Doris longicornis*, Mont., in Linn. Trans., v. 9, p. 107, pl. 7, fig. 1.

*Eolida plumosa*, Flem., Brit. Anim., p. 285.

An inspection of the original sketch of Dr. Fleming's *E. plumosa* induces us to think that it is the young of *E. coronata*. The characters of the head and tentacles\* exactly correspond with this species, and the paucity of branchial papillæ may be accounted for by supposing the specimen to have been injured, as these organs very readily fall off.

With regard to the *Doris longicornis* of Montagu, we cannot speak with confidence, but an examination of the southern coasts of Devonshire and Cornwall has brought to light no species excepting *Eolis coronata* that could with any probability be referred to it. In Fowey Harbour we got some large specimens of a curious variety of the latter. The branchiæ were of a less vivid red than usual, and they, as well as the back, were much spotted with pale blue or bluish-white; in this particular agreeing with Montagu's description of *longicornis*, in which the "cirri" are stated to be of a pink colour spotted with white. His figure is so bad that little reliance can be placed upon it. It appears, from its general contour, to represent an *Eolis* of the section with clustered branchiæ in which some of the anterior clusters had fallen off, and one of them was in progress of being reproduced. The colour of these organs shows a mixture of blue with the pink, in which also it agrees with *E. coronata*. We do not, therefore, feel sufficient confidence in its distinctness to give the species a place in our Synopsis, but shall insert Montagu's description here as a guide for further investigation.

"*Doris longicornis*. Body long, slender, posterior end acuminate; head rounded in front:

\* Dr. Fleming informs us that the word "dextral" in the description of the tentacles is a mistake of the printer, and ought to be "distal."

tentacula four, of which the first pair are very long, setiform, and extended forward; the other pair are remote, short, and erect: eyes two, small and black, situated at the base of the hindmost tentacula: on the right side near the eyes is a cluster of short cirri; and at a little distance from these commence four series of longer ones, of a pink colour, spotted with white, standing transversely, and extending down the sides; these cover the middle of the animal; the other parts are yellowish-white tinged with pink about the eyes. Length half an inch."

(21) *EOLIS DRUMMONDI*.

We found a remarkable variety of this species in the Menai Straits, opposite Bangor, with the branchiæ of a sage-green colour: of this, two specimens occurred. Others in the same locality had these organs of a brownish-drab. *E. Drummondi* is subject to great variety of tint in the colour of the branchiæ, but so great a variation of colour as from a reddish to a greenish hue we were not prepared to expect.

(22) *EOLIS LANDSBURGII*.

? *Doris pedata*, Mont., in Linn. Trans., v. 11, p. 197, pl. 14, fig. 2.

*Additional Habitats.* Hilbre Island, Mouth of the Dee, *I. Byerley, Esq.* Exmouth, *Rev. T. Hincks.* Island in Menai Straits, *Miss Hughes*; also dredged in the Straits, *J. A. Burghead, Elgin, Geo. Murray, Esq.*

An opportunity of seeing fine full-grown specimens of this lovely *Eolis* enables us to say that our drawing represents the species in a rather immature state. The branchiæ in adult specimens are longer and rather more numerous than there represented. The animal attains the size of nearly half an inch. We are now disposed to think that this species may possibly be the *Doris pedata* of Montagu, whose description agrees pretty well with our animal, though the figure is anything but a good representation of it.

(23) *EOLIS ALBA*.

*Eolis alba*, Lovén, Ind. Moll. Scand., p. 8.

*Additional Habitats.* Falmouth, *W. P. Cocks, Esq.* Ardrossan and Saltcoats, Ayrshire; and Lamlash Bay, Arran, *J. A. Burghead, Elgin, G. Murray, Esq.*

This species is liable to curious variations of colour, becoming sometimes so dark as almost to render the specific name inappropriate: the prevailing colour, however, is usually white. In June, 1847, we got, among the rocks on the north side of Lamlash Bay, two remarkable varieties. The branchiæ in one were darkish purple-brown with white spots, and in the other yellowish-brown, also spotted with white; in both the body had transverse bands of brown at the sides, which were united in pairs dorsally, so as to form loops round the base of each cluster of branchiæ: a dark brown band extended across the back opposite the first row of papillæ. The oral tentacles were not much longer than the dorsal pair, and these latter had two bulbous swellings, the one half-way up the dark part of the tentacle, and the other at the top of it. The largest individual measured three quarters of an inch; it had one

of the papillæ branched. On the shore of the Holy Isle in the same bay, we got a specimen seven eighths of an inch long, entirely white; and two others, smaller, which had the branchiæ yellowish, spotted with brown, and brown rings at the tips: the body was marked with brown bands similar to those described above.

Professor Lovén has found *Eolis alba* in Norway. He remarks of it, "Branchiæ in meis sæpius testaceæ, niveo-punctatæ, sed inedia decolorantur."

(24) *EOLIS CARNEA*.

In 1843, we received a specimen of this *Eolis* in spirits from Mrs. Wyatt, of Torquay, who had dredged it in Salcombe Bay. We deferred publishing it, hoping to have met with it in a living state, but in this we have been disappointed. The species is interesting on account of its close relationship to *E. alba*, having the same arrangement of the branchiæ in imperfect clusters or double rows anteriorly, as well as the dark dorsal tentacles. We could not ascertain that these latter had the bulbous swelling, but this character usually disappears in spirits. The tongue has a single plain spine in each row as in *E. alba*. The specimen examined when recent (in spirits) had the body of a pale rose- or flesh-colour, long and slender. The branchiæ were rose-red, rather conical, and set in seven clusters, the three anterior ones containing two rows each (five or six papillæ in each row); the others were in single series. The first cluster approached close to the dorsal tentacles. These tentacles were plain, slightly conical, dark olive-brown, or nearly black, paler above, and approximating at the base. The oral tentacles were about the same length as the dorsal pair, transparent white, tapering to a point. Foot slightly bilobed in front, the angles produced into very long tentacular points at the sides.

We are now inclined to refer the *Eolidia Cuvierii* of Johnston, found in Berwick Bay (Ann. Nat. Hist., v. 1, p. 120, pl. 3, figs. 9—11), to this species, which has the branchiæ arranged much in the same manner. The dorsal tentacles, however, are not so dark-coloured; they are called "olivaceous with yellowish tips." However the case may be, we do not think that Dr. Johnston's animal can be the "Eolide" described by Cuvier (*Eolis Cuvieri*, Lam.); a species that it would be difficult now to identify, and which has been much misunderstood by French writers.

In this state of uncertainty concerning the Berwick specimen, we do not feel inclined to give it a separate place in our list. The *Eolis Cuvierii* of Macgillivray appears to be something different that we cannot make out.

(25) *EOLIS INORNATA*.

*Eolis inornata*, Ald. and Hanc., in Ann. Nat. Hist., v. 16, p. 315.

*Hab.* Under a stone near low-water mark, Torquay, *J. A.*

Body rather less than half an inch in length, ovate, and rather flattish, pale fawn-coloured, or nearly white. Dorsal tentacles short and stout, yellowish, slightly wrinkled; eyes large and conspicuous at their posterior base. Oral tentacles short, white, about equal in length to the dorsal pair. Branchiæ cylindrical, tapering a little and obtusely pointed, of a dull

brownish-orange freckled with dark brown and white. The apex for some distance down is transparent white, and the ovate vesicle of a more opaque white is distinctly seen through it: the papillæ are arranged in eight or nine rows of four or five each. Foot transparent white, very broad in front, and extended into short angles at the sides.

This species comes very near to *E. angulata*, of which it may possibly prove to be a variety. It differs, however, in colour, and somewhat in the proportions of the parts, particularly in the shortness of the anterior angles of the foot. When it is crawling, the branchiæ close so as to cover the whole of the back. The colour and markings resemble a good deal some of the varieties of *E. papillosa*. The species is founded on a single specimen, got at low-water mark, at the Gentlemen's Cove, Torquay, which unfortunately was not preserved; some doubt may therefore rest on its specific distinction until it can be again examined.

(26) *EOLIS OLIVACEA*.

*Additional Habitats.* Ardrossan and Saltcoats, Ayrshire; Lamlash, Isle of Arran; and Penzance, Cornwall, *J. A. Burghead, Geo. Murray, Esq.*

This species appears to be very generally diffused. The *Eolis foliata* of Forbes and Goodsir, in the 'Report of the British Association' for 1839, we take to be the young of *E. olivacea*. It was found in Shetland.

(27) *EOLIS COUCHII*.

*Eolis Couchii*, Cocks, in *Naturalist*, v. 2, p. 1, pl. 1, fig. 2.

Body an inch and three quarters or nearly two inches long; the anterior part to the commencement of the branchiæ is white, as is also the tail, the rest of the body is of a bluish-black, with opaque white spots. The dorsal tentacles are rather long and filiform, the oral somewhat shorter and stouter; both pairs are transparent white with opaque spots. Eyes conspicuous and black. The branchiæ are ovate-oblong, transparent white with opaque white spots, and are arranged in four distant rows of three papillæ each down the sides of the back. The foot is whitish and much attenuated posteriorly.

We owe the discovery of this fine *Eolis* to Mr. Cocks, who found it attached to the under side of a stone on the coral bank at Gwyllyn Vase, Falmouth, at the extreme low-water mark of a spring tide in August, 1848. Mr. Cocks kept it alive nearly three months. It was sluggish in its movements and generally held its papillæ in a semi-erect position.

(28) *EOLIS AMÆNA*.

We dredged several specimens of this beautiful species in Fowey Harbour, Cornwall, in May, 1847. Individuals varied very much in colour, and a little in the length of the tentacles, but the latter always retained the single brown band, and they and the branchiæ were always spotted with white or pale yellow. The colour of the papillæ varied from yellowish-green to pale yellowish-olive, and occasionally to a pale yellowish-brown. One of the specimens had the bases of the papillæ reddish and was blotched with opaque white down the front of each.

(29) *EOLIS PURPURASCENS.*

*Eolida purpurascens*, Flem., Phil. Zool., v. 2, p. 470, pl. 4, fig. 2. Brit Anim., p. 285.

*Hab.* Frith of Tay, *Rev. Dr. Fleming.*

“Five bundles of branchiæ on each side. Tentacula linear. Length about an inch, slender, pointed behind, rounded in front, of a pink colour. Anteal tentacula shorter than the superior ones, which have the eyes behind. Three filiform branchiæ in each bundle.”

This description from Dr. Fleming’s ‘British Animals,’ and the figure in his ‘Philosophy of Zoology,’ afford all the information we possess concerning this rare *Eolis*, which appears to be different from anything we have met with. The figure represents the oral tentacles very short; the papillæ are also short and subclavate, and are set in rather distant rows.

(30) *EOLIS CÆRULEA.*

*Doris cærulea*, Mont., in Linn. Trans., v. 7, p. 78, pl. 7, figs. 4, 5.

*Montagua cærulea*, Flem., Brit. Anim., p. 285.

“With a linear body of a green colour, covered with large, blue, clavated tubercles, greenish at their base, and tipped with orange; these are disposed in several transverse rows: tentacula four, subfiliform, green: eyes placed at the base of the hindmost tentacula; between the second and third row of tubercles are two pink oval vesicles on the back, a little inclining to one side. Length a quarter of an inch.” Montagu, *loc. cit.*

We have not succeeded in our search for this pretty species on the Devonshire and Cornish coasts, and can therefore add nothing to the above description. The two pink oval vesicles mentioned are evidently the ovigerous vesicles of a parasite of the *Lerneæ* tribe that infests these animals.

(31) *EOLIS AMETHYSTINA.*

*Eolis amethystina*, Ald. and Hanc., in Ann. Nat. Hist., v. 16, p. 316.

Body yellowish, slightly depressed. Oral and dorsal tentacles of a yellowish tinge, the latter twice as long as the former, bases approximating, points fine and spreading. Branchiæ elliptical, much inflated one way and somewhat depressed the other, set in nine or ten rows of four papillæ each; the gland linear, purple, granulated; apices with a broad ring of pale orange-red. Foot transparent, linear, rounded in front, and a little widened for a considerable way backwards. Length three eighths of an inch.

Found under a stone at low-water mark, Cullercoats, *A. H.*

This is a critical species coming very near to *E. tricolor*, from which it differs principally in the greater length of the tentacles, and in having the papillary gland purple throughout its entire length, and strongly granulated. The specimen was taken in October, and as it did not contain spawn it is difficult to say whether or not it was adult.

(32) *EOLIS FARRANI.*

This species has lately been found in considerable abundance at Burghead, on the Elgin coast, by Mr. Murray. The Scottish specimens are generally of a purplish-violet tinge on the body and papillæ. This is probably the normal colour, and the individual from which the drawings in our plate were taken must therefore be considered a white variety, examples of

which are occasionally found on the Elgin coast. Mr. Murray states that the papillæ are generally "coloured externally with an indistinct purple, partaking largely of an umber tint, through which, in some cases, the narrow straw-coloured central vessel is faintly visible. In some the papillæ are very dark, the umber predominating over the purple, and in this case, a very marked and striking contrast of colour is caused by the apex being generally whitish, with only a very slight tinge of orange. In others the purple colouring of the body is so faint as to be scarcely perceptible." One or two individuals kindly sent to us in a living state, were of a very delicate violet colour. The orange markings represented in our plate appear to be pretty constant. The Scottish specimens were half an inch in length.

(33) *EOLIS EXIGUA*.

*Additional Habitats.* Garth Ferry, Bangor, North Wales, *J. A.* Cullercoats, Northumberland, *A. H.* Burghead, Elgin, *G. Murray, Esq.*

(34) *EOLIS DESPECTA*.

*Additional Habitats.* Falmouth, *W. P. Cocks, Esq.* Fowey Harbour; and Garth Ferry, Bangor, *J. A.* Burghead, *G. Murray, Esq.* In all these instances it was in company with *E. exigua*.

(35) *EMBLETONIA MINUTA*.

*Eolidia minuta*, For. and Goods., in Rep. Brit. Assoc., 1839. Athenæum, No. 618, p. 647.  
*Embletonia minuta*, For. and Hanl., Brit. Moll., v. 3, p. 607, pl. B B B, fig. 5.

Dredged in seven fathoms among *Laminariæ* at Lerwick, Shetland, *Professor E. Forbes*. The species comes very near to *E. pulchra*, but judging from the figure it appears to be more slender in all its proportions.

(36) *EMBLETONIA PALLIDA*.

A specimen of this minute species, discovered by Mr. Price, among sea-weeds, on the shore at Birkenhead, was obligingly sent us by that gentleman in the spring of this year (1854). It differs from the other British species in having a double series of papillæ on each side; the tentacles, too, are placed much nearer together, and the oral lobes are small and indistinct, being united over the head in front into a semicircular veil, which, Mr. Price informs us, was in constant motion when the animal was in a lively state.

(37) *HERMÆA*, from Ερμαιον=*Lucrum insperatum*, Lovén, in lit.

(38) *ANTIOPA HYALINA*.

Mr. Byerley has sent us a second specimen of this species, more mature and in better condition than the first, which arrived dead. This differs from the former in the greater length and more pointed character of the dorsal tentacles. The papillæ are much attenuated and elongated above, with the point enlarged and obtuse; the gland is darker and a little branched. The tail, also, is more produced. Length  $\frac{3}{4}$  inch.

The second volume of Sir John G. Dalyell's 'Powers of the Creator displayed in the Creation' not having appeared in time to allow of our including the Nudibranchs there described in our synonyms, we take the opportunity of giving a list of them here, with our opinion as to the species to which they should be referred. This may be found useful in consequence of the imperfect descriptions and figures of some of the species, concerning which it is scarcely possible to form more than a conjecture.

<i>Tritonia Hombergii</i> , <i>Daly.</i>	=	<i>Tritonia Hombergii</i> and <i>T. plebeia</i> , <i>A.</i> and <i>H.</i> Most of the smaller figures belong to the latter.
<i>cervina</i>	=	<i>Dendronotus arborescens</i> .
<i>pinnatifida</i>	=	<i>Doto fragilis</i> .
<i>punctata</i>	=	<i>coronata</i> .
<i>divaricata</i>		May be <i>D. pinnatifida</i> , Mont., or a variety of the last. The description is not sufficient for identifying it.
<i>conifera</i>	=	<i>Doto fragilis</i> , a <i>lusus</i> .
<i>Doris verrucosa</i>	=	<i>Doris bilamellata</i> .
<i>argo</i>	=	<i>tuberculata</i> .
<i>nodosa</i>	=	<i>Goniodoris nodosa</i> .
<i>cristata</i>	=	<i>Ancula cristata</i> .
<i>clavigera</i>	=	<i>Triopa claviger</i> .
<i>Eolis plumata</i>	=	Young of <i>Eolis papillosa</i> ? The branchiæ are coloured green in the figure, but in the description the colour is stated to be "universally grayish; tips of the branchiæ clear."
<i>racemosa</i>	=	<i>Eolis picta</i> ?
<i>minor</i>		Cannot be identified; perhaps <i>E. vittata</i> ?
<i>deaurata</i>	=	<i>Eolis Glottensis</i> ?
<i>viridis</i>	=	<i>viridis</i> , most probably.
<i>sanguifer</i>		Cannot be identified; perhaps new, but it has somewhat the appearance of a variety of <i>E. aurantiaca</i> we have met with from deep water, with pale tips to the branchiæ.
<i>consersa</i>	=	<i>Eolis olivacea</i> .
<i>inequalis</i>	=	<i>tricolor</i> ?
<i>monoceros</i>	=	A <i>lusus</i> with the tentacles fused together at the base. From the rings represented on the upper part of the tentacles, the species is probably <i>E. coronata</i> .
<i>tenax</i>	=	<i>Eolis rufibranchialis</i> or <i>E. lineata</i> .
<i>histris</i>	=	<i>Drummondi</i> .
<i>purpurea</i>	=	<i>coronata</i> .
<i>papillosa</i>	=	<i>papillosa</i> .
<i>ventilabrum</i>	=	<i>Embletonia pulchra</i> .

## SKETCH OF A GENERAL ARRANGEMENT

OF THE

## NUDIBRANCHIATE MOLLUSCA.

## ORDER—NUDIBRANCHIATA.

Sub-Order—ACANTHOBRANCHIATA, *Ferussac*.

Branchiæ on the medio-dorsal line; skin spiculose.

GEN.

- |                                                                                                                                                            |   |                                                                                                                                                                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Fam. 1. DORIDIDÆ. Cloak large, without marginal appendages; dorsal tentacles 2, retractile within cavities; oral tentacles 2, various or wanting . . . . . | { | 1. Doris.<br>2. Chromodoris.<br>3. Lamellidoris.<br>4. Hexabbranchus.<br>5. Acanthodoris.                                                                              |
| Fam. 2. POLYCERIDÆ. Cloak small or obsolete, generally with marginal appendages; tentacles variable; mouth occasionally provided with jaws . . . . .       | { | 6. Goniodoris.<br>7. Idalia.<br>8. Ancula.<br>9. Polycera.<br>10. Thecacera.<br>11. Triopa.<br>12. Euplocamus.<br>13. Plocamophorus.<br>14. Ægirus.<br>15. Ceratosoma. |

Sub-Order—POLYBRANCHIATA, *Ferussac*.

Branchiæ arranged along the sides of the body; skin generally without spicula.

*Tribe 1.* Liver generally central; branchiæ laminated.*Section 1.* With the branchiæ on the under side of the cloak.

- |                                                                                                                                                                                                                        |   |                                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|--------------------------------|
| Fam. 3. PHYLLIDIADÆ. Cloak large, spiculose; dorsal tentacles 2, retractile within cavities in the cloak; oral tentacles 2; anus postero-dorsal; mouth without jaws . . . . .                                          | { | 16. Phyllidia.<br>17. Fryeria. |
| Fam. 4. DIPHYLLIDIADÆ. Cloak large; dorsal tentacles 2, situated in front of the cloak, with a veil above the head; anus lateral; digestive organs with a rudimentary gastro-hepatic system; mouth with jaws . . . . . | { | 18. Diphyllidia.               |



*Section 2.* With the branchiæ on the upper side of the cloak.

- GEN.
- Fam. 5. TRITONIDÆ. Body subquadrilateral; cloak small; veil large; projecting in front of the head; branchiæ arranged on the pallial ridge; anus lateral; jaws large } 19. Tritonia.
- Fam. 6. SCYLLÆIDÆ. Body compressed; cloak produced into lateral lobes, bearing the branchial plumes; anus lateral; mouth with jaws } 20. Scyllæa.

*Tribe 2.* Liver diffused; branchiæ papillose, simple, or branched.*Section 1.* With a posterior central gastro-hepatic vessel; reproductive organs with a single external orifice.*A.* With the posterior vessel of the gastro-hepatic system below the ovary.

- Fam. 7. DENDRONOTIDÆ. Tentacles 2, dorsal, usually laminated and retractile within sheaths; branchiæ branched or papillose, in a single series along the sides of the back; veil small; anus lateral; mouth with jaws } 21. Dendronotus.  
22. Bornellia.  
23. Lomanotus.  
24. Hero.
- Fam. 8. TETHIDÆ. Body depressed; cloak indistinct; veil very large, funnel-shaped; tentacles 2, dorsal; branchial plumes alternating with papillæ; anus latero-dorsal; no jaws } 25. Tethys.
- Fam. 9. MELIBIDÆ. Cloak wanting; tentacles 2, simple, retractile within sheaths; branchiæ clavate, muricated or tuberculated, set in single series on each side of the back; anus latero-dorsal; no jaws } 26. Melibe.  
27. Doto.
- Fam. 10. PROCTONOTIDÆ. Body depressed; tentacles 4, dorsal pair non-retractile, without sheaths, oral pair small; branchiæ fusiform, arranged on an obsolete pallial ridge, on each side of the back, and in front of the head; anus postero-dorsal; mouth with jaws } 28. Proctonotus.  
29. Antiopa.
- Fam. 11. GLAUCIDÆ. Body elongated; tentacles 4, linear, simple, non-retractile; branchiæ arranged in a palmate form on extended footstalks; anus lateral; mouth with jaws } 30. Glaucus.

*B.* With the posterior vessel of the gastro-hepatic system above the ovary.

- Fam. 12. EOLIDIDÆ. Without cloak; tentacles 4, non-retractile, variable; branchiæ simple, papillose or linear; anus lateral; mouth with jaws } 31. Calma.  
32. Flabellina.  
33. Facelina.  
34. Coryphella.  
35. Favorinus.  
36. Phidiana.  
37. Eolis.  
38. Cuthona.  
39. Cavolina.  
40. Galvina.  
41. Tergipes.  
42. Embletonia.

*Section 2.* With 2 posterior lateral gastro-hepatic vessels; reproductive organs with 2 external orifices.

- |                    |                                                                                       |                                                |
|--------------------|---------------------------------------------------------------------------------------|------------------------------------------------|
|                    |                                                                                       | GEN.                                           |
| Fam. 13. FRONIDÆ.  | Tentacles 4 simple; branchiæ papillose, numerous; anus latero-dorsal; mouth with jaws | } 43. Fiona.                                   |
| Fam. 14. HERMÆIDÆ. | Tentacles 2, dorsal; branchiæ papillose; anus dorsal; no jaws                         |                                                |
|                    |                                                                                       | } 44. Hermæa.<br>45. Stiliger.<br>46. Alderia. |

Sub-Order—PELLIBRANCHIATA, *A.* and *H.*

Without special branchiæ; skin without spicula.

*Tribe 1.* Body limaciform.

- |                        |                                                                                                                                                               |                                     |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| Fam. 15. ELYSIADÆ.     | Tentacles 2 or 4; body furnished with 2 lateral expansions or folds; gastro-hepatic system, much branched; anus latero-dorsal, in front of the heart; no jaws | } 47. Placobranchus.<br>48. Elysia. |
| Fam. 16. LIMAPONTIADÆ. | Tentacles 2, or wanting; back without appendages; anus dorsal, posterior; no jaws                                                                             |                                     |
|                        |                                                                                                                                                               | } 49. Acteonia.<br>50. Limapontia.  |

*Tribe 2.* Body cylindrical or compressed.

- |                         |                                                                                                        |                   |
|-------------------------|--------------------------------------------------------------------------------------------------------|-------------------|
| Fam. 17. PHYLLIRRHOIDÆ. | Tentacles 2, dorsal, linear, retractile; head distinct; tail compressed; mouth with jaws; anus lateral | } 51. Phyllirrhœ. |
|                         |                                                                                                        |                   |

## SYNOPSIS OF THE GENERA.

Sub-Order—ACANTHOBANCHIATA.

Fam. 1. *Dorididæ*.

TYPE.

- Gen. 1. DORIS, *Linn.* Body depressed; cloak covering the head and foot; branchiæ united at the base and retractile within a cavity; dorsal tentacles laminated; with oral tentacles. *Tongue broad, with numerous spines in each row*
- |    |                                                                                                                                                            |                                   |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| a. | Dorsal tentacles conical; oral tentacles tubercular; cloak with hard spiculose tubercles. <i>Lingual spines simple, uniform; no central spine</i>          | D. tuberculata, <i>Cuv.</i>       |
| b. | Dorsal tentacles conical; oral tentacles tubercular; cloak with soft tubercles. <i>Lingual spines long, linear, obtuse, denticulated; no central spine</i> | D. Zetlandica, <i>A. &amp; H.</i> |
| c. | Dorsal tentacles clavate; oral tentacles linear. <i>Lingual spines of two forms; no central spine</i>                                                      | D. Johnstoni, <i>A. &amp; H.</i>  |

## TYPE.

- d. Dorsal tentacles linear; oral tentacles angular, flattened. *Lingual spines denticulated; a small central spine. Mouth with a spinous collar* . . . . . D. repanda, A. & H.
- e. Dorsal tentacles conical, partially retractile, and protected by leaf-like appendages; oral tentacles linear or tubercular; branchiæ linear, simply pinnate; cloak with large tubercles. *Lingual spines simple, uniform; no central spine.* GLOSSODORIS, Ehr. . . . . D. verrucosa, Cuv.
- f. Dorsal tentacles conical; oral tentacles leaf-shaped; branchiæ each with several pinnate rays branching from a footstalk; cloak very large, flat, and coriaceous. *Lingual spines?* ACTINODORIS, Ehr. . . . . D. cruenta, Q. & G.
- g. ? With only two tentacles; branchiæ in front of the anus, not surrounding it. *Lingual spines?* ACTINOCYCLUS, Ehr. . . . . A. vetulinus, Ehr.
- h. ? Dorsal tentacles truncated; branchiæ small; cloak large, carinated on the back. *Lingual spines?* ATAGEMA, Gray. . . . . D. carinata, Q. & G.
- Gen. 2. CHROMODORIS, A. and H. Body subquadrilateral; cloak narrow, exposing the foot, smooth; dorsal tentacles laminated, retractile within plain or marginated cavities; oral tentacles conical or tubercular; branchiæ linear, simply pinnate, retractile? *Tongue?* . . . . . D. magnifica, Q. & G.
- Gen. 3. LAMELLIDORIS, A. and H. Body depressed; cloak large; dorsal tentacles laminated; head with a veil; no oral tentacles; branchiæ simply pinnate, set in an open circle, non-retractile. *Tongue narrow, with few spines.*
- a. Body not greatly depressed; cloak with moderate-sized spicula; spawn of few coils, cup-formed. *Tongue with 2 large spines and 2 or more rudimentary ones; usually a simple central plate* . . . . . D. bilamellata, Linn.
- b. Body very flat, with large spicula, symmetrically arranged; spawn of many narrow coils. *Tongue with 2 large broad spines and 2 rudimentary ones; no central plate* . . . . . D. depressa, A. & H.
- Gen. 4. HEXABRANCHUS, Ehr. Cloak very large and flat, with an undulating margin; dorsal tentacles laminated, kneed, retractile within marginated cavities; oral tentacles large, ovate, with scalloped edges; branchiæ generally in 6 tufts, set separately round the vent and non-retractile. *Tongue?* . . . . . H. pretextus, Ehr.
- Gen. 5. ACANTHODORIS, Gray. Body convex; cloak with soft conical tubercles; dorsal tentacles laminated, retractile within marginated cavities; oral tentacles leaf-shaped, united into a veil; branchiæ united at the base, non-retractile. *Tongue narrow, with 2 large denticulated spines and 6 or 8 rudimentary ones; no central plate. A spinous buccal collar, with a rudimentary under jaw* . . . . . D. pilosa, Müll.

Fam. 2. *Polyceridæ*.

## Section 1. Tentacles non-retractile.

- Gen. 6. GONIODORIS, *For.* Body depressed; cloak distinct, with a waved or scalloped margin; dorsal tentacles laminated; oral tentacles flattened; branchiæ non-retractile. *Tongue narrow, with 4 plates, the two next the median line bearing each a large spine; no central plate. A spinous buccal collar* . . . G. nodosa, *Mont.* TYPE.
- Gen. 7. IDALIA, *Leuck.* Body convex, smooth; cloak very small and indistinct, margined with filaments, longest in front of the tentacles; head much produced in front, plain, thick; tentacles 2, dorsal, linear, laminated; branchiæ simply pinnate, non-retractile. *Tongue narrow, with 4 spines, the 2 next the median line large; no central spine. A spinous buccal collar.*
- a. Centre of the back with filaments. *Lingual spines next the centre falcate, and smooth or minutely denticulated; external spines short. Spinous collar complete* . . . I. elegans, *Leuck.*
- b. Centre of the back without filaments. *Lingual spines next the centre recurved and strongly denticulated; external spines much hooked. Spinous collar incomplete, bilobed* . . . I. aspersa, *A. & H.*
- Gen. 8. ANCULA, *Lovén.* Body limaciform, smooth; cloak obsolete, forming an indistinct ridge near the gills bearing several appendages; tentacles 2, clavate, laminated, non-retractile, with styliform basal appendages; head produced at the sides into tentacular processes; branchiæ non-retractile. *Tongue narrow, with 4 spines, the 2 next the median line large and broad, with the inner margin denticulated; no central spine. A spinous buccal collar* . . . A. cristata, *Ald.*
- Gen. 9. POLYCERA, *Cuv.* Body limaciform; cloak indistinct, forming a digitated veil and a ridge bearing a row of tubercles on each side of the back; tentacles 2, laminated; branchial plumes non-retractile, with lateral appendages. *Tongue rather narrow, with 12 to 16 plates, the 2 next the centre on each side large, bicuspid; no central plate. Lateral corneous jaws.*
- a. Veil dilated into tentacular filaments; branchial plumes simply pinnate; branchial appendages linear, one on each side . . . P. quadrilineata, *Müll.*
- b. Veil short, bilobed, margin tuberculated; branchial plumes branched; branchial appendages tubercular, more than one on each side . . . P. ocellata, *A. & H.*

## Section 2. Tentacles retractile within sheaths.

- Gen. 10. THECACERA, *Flem.* Body limaciform, smooth; cloak obsolete; veil indistinct, or none; tentacles 2, laminated; branchial plumes non-retractile, with lateral appendages. *Tongue with 12 or 14 plates, the 2 inner plates on each side bearing bicuspid spines; no central plate. Small lateral corneous jaws* . . . T. peniigera, *Mont.*

- Gen. 11. *TRIOPA*, *Johns*. Body depressed; cloak small, covering the head, with linear, or subclavate marginal appendages; dorsal tentacles laminated, with tight sheaths; oral tentacles cylindrical; branchiæ non-retractile. *Tongue rather broad, with numerous plates, the two innermost on each side bearing large spines; no central plate* . . . . . TYPE.  
T. *claviger*, *Müll.*
- Gen. 12. *EUPLOCAMUS*, *Phil.* Body rather depressed; cloak small, covering the head, the margin surrounded with branched appendages; dorsal tentacles laminated; oral tentacles in form of oval lobes; branchiæ non-retractile. *Tongue broad, with numerous elongated plates, the 3 innermost on each side bearing large, broad spines: no central plate. A spinous buccal collar* . . . E. *croceus*, *Phil.*
- Gen. 13. *PLOCAMOPHERUS*, *Rupp.* (*Peplidia*, *Lowe.*) Body limaciform; cloak obsolete, forming an expanded veil over the head, with branched appendages, and 2 or 3 tubercles on each side of the back; dorsal tentacles laminated; oral tentacles flat; branchiæ branched, non-retractile; a fin-like carinated ridge down the posterior part of the back to the tail. *Tongue? Jaws?* . . . P. *ocellatus*, *Rupp.*
- Gen. 14. *ÆGIRUS*, *Lovén.* Body convex, covered with large tubercles; cloak indistinct, forming a veil over the head and a tuberculated ridge on each side; dorsal tentacles 2, linear, smooth, with wide sheaths; branchial plumes non-retractile. *Tongue broad, with numerous simple, curved, lateral spines; no central plate. An upper corneous jaw* . . . . . Æ. *punctilucens*, *D'Orb.*
- Gen. 15. *CERATOSOMA*, *Gray.* Body elevated; cloak wanting; dorsal tentacles laminated, retractile; branchiæ retractile within a cavity; back produced posteriorly into a conical protuberance behind the branchiæ. *Tongue broad, with numerous rows of simple spines; no central spine. A spinous buccal collar* . . . C. *trilobata*, *Gray.*

## Sub-Order—POLYBRANCHIATA.

Tribe 1. Liver generally central; branchiæ laminated.

Section 1. With the branchiæ on the under side of the cloak.

Fam. 3. *Phyllidiadæ.*

- Gen. 16. *PHYLLIDIA*, *Cuv.* Cloak covering the whole body, tuberculated or pustulated; dorsal tentacles laminated; oral tentacles small, linear; branchiæ surrounding the body, interrupted only by the head; anus median, in the posterior part of the cloak. No tongue. No jaws . . . . . P. *trilineata*, *Cuv.*
- Gen. 17. *FRYERIA*, *Gray.* Like the last, but with the anus situated beneath the cloak posteriorly . . . . . F. *pustulosa*, *Cuv.*

Fam. 4. *Diphyllidiadæ*.

- Gen. 18. DIPHYLLIDIA, *Cuv.* Cloak exposing the head, coriaceous; tentacles laminated longitudinally, approximated, partially retractile within a common cavity; veil reflected; branchiæ of two kinds, the anterior longitudinally folded, the posterior transversely. *Tongue broad, with numerous simple lateral spines and a denticulated central spine. Corneous jaws* . . . D. lineata, *Otto*.

TYPE.

*Section 2.* With the branchiæ on the upper side of the cloak.

Fam. 5. *Tritoniadæ*.

- Gen. 19. TRITONIA, *Cuv.* Branchiæ plumose; tentacles 2, fasciculated, retractile within plain sheaths; veil digitated. *Tongue broad, with numerous simple or denticulated lateral spines, a tricuspid central spine, and a broad plate on each side of it. Large corneous jaws* . . . . . T. Hombergii, *Cuv.*

Fam. 6. *Scyllæidæ*.

- Gen. 20. SCYLLÆA, *Linn.* Branchiæ plumose, scattered over the lateral lobes on the inner surface; veil small; tentacles 2, laminated, with large compressed sheaths. *Tongue broad, with numerous lateral spines and a central spine, all denticulated. Large corneous jaws* . . . . . S. pelagica, *Linn.*

*Tribe 2.* Liver diffused; branchiæ papillose, simple or branched.

*Section 1.* With a posterior central gastro-hepatic vessel; reproductive organs with a single external orifice.

A. With the posterior vessel of the gastro-hepatic system below the ovary.

Fam. 7. *Dendronotidæ*.

- Gen. 21. DENDRONOTUS, *A. and H.* Body compressed, without cloak; branchiæ ramose; veil branched; tentacles laminated, with branched sheaths. *Tongue rather narrow, with several lateral spines, and a larger central spine, all denticulated* . . . D. arborescens, *Mull.*
- Gen. 22. BORNELLA, *Gray.* Body compressed, without cloak; tentacles 2, retractile within branched sheaths; front of the head with 2 stellated or fimbriated appendages; branchiæ plumose, arranged on plain branched pedicles. *Tongue?* . . . B. digitata, *Adams.*
- Gen. 23. LOMANOTUS, *Ver.* Body subquadrilateral; branchiæ papillose or foliaceous, arranged in a nearly continuous line on a pallial margin; tentacles 2, laminated, with sheaths. *Tongue broad, with numerous denticulated spines; no central spine. Corneous jaws* . . . . . L. Genei, *Ver.*
- Gen. 24. HERO, *Lov.* Cloak wanting; tentacles 2, linear, simple, non-retractile; veil rather large, plain, produced at the sides; branchiæ branched or umbellated. *Tongue with a large central denticulated spine, and 2 simple lateral spines. Corneous jaws* . . . H. formosa, *Lov.*

Fam. 8. *Tethidæ*.

- Gen. 25. TETHYS, *Linn.* Body depressed, with numerous branchial plumes or tufts alternating with papillæ on each side of the back; veil fringed with filaments; tentacles laminated, sheathed. *No tongue. No jaws* . . . . . TYPE.  
T. leporina, *Linn.*

Fam. 9. *Melibinæ*.

- Gen. 26. MELIBE, *Rang.* Tentacles small, retractile within long, narrow, trumpet-shaped sheaths; veil large, funnel-shaped, fringed internally; branchiæ ovate, tuberculated. *Tongue?* . . . M. rosea, *Rang.*
- Gen. 27. DOTO, *Oken.* Tentacles linear, long, with short, wide, trumpet-shaped sheaths; veil small, plain; branchiæ ovate, muricated. *Tongue narrow, with a large central spine* . . . D. fragilis, *For.*

Fam. 10. *Proctonotidæ*.

- Gen. 28. PROCTONOTUS, *A. and H.* Dorsal tentacles simple, linear; veil distinct, notched in front. *Tongue broad, with numerous smooth spines. Jaws plain* . . . P. mucroniferus, *A. & H.*
- Gen. 29. ANTIOPA, *A. and H.* Dorsal tentacles laminated, united by a semicircular crest; oral tentacles with or without a veil. *Tongue broad, with numerous lateral spines and a central one, all simple. Jaws denticulated* . . . A. cristata, *Delle Ch.*

Fam. 11. *Glaucidæ*.

- Gen. 30. GLAUCUS, *Linn.* Head indistinct; tentacles very short; branchiæ compressed, tapering, arranged on broad flattened footstalks; foot very narrow, rounded in front. *Tongue narrow, with a single plate, bearing a long stout spine and marginal denticles* . . . G. Forsteri.

B. With the posterior vessel of the gastro-hepatic system above the ovary.

Fam. 12. *Eolididæ*.

- Gen. 31. CALMA, *A. and H.* Body depressed, rather broad; tentacles small, simple, linear; branchiæ linear-fusiform, clustered on cylindrical footstalks; foot broad, anterior angles acute. *Tongue very small and narrow, bearing a single spine* . . . C. glaucoides, *A. & H.*
- Gen. 32. FLABELLINA, *Cuv.* Body slender; dorsal tentacles laminated; oral tentacles long; branchiæ linear or fusiform, clustered on footstalks; foot narrow, anterior angles much produced. *Tongue a central spine with marginal denticles, and two separate plain lateral spines* . . . F. affinis, *Gm. ?\**

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\* The *Eolidia flabellina* of Verany belongs to this genus; his *E. affinis* appears to be different from that of Gmelin.

- Gen. 33. *FACELINA*, *A.* and *H.* Body rather slender; dorsal tentacles laminated; oral tentacles long; branchiæ linear, or fusiform, clustered; foot narrow, with the anterior angles acute and much produced. Spawn of many undulating coils. *Tongue, a single plate with a large central spine and marginal denticles* . . . . . TYPE.  
F. coronata, *For.*
- Gen. 34. *CORYPHELLA*, *Gray.* Body slender; dorsal tentacles simple; branchiæ linear or fusiform, clustered; foot narrow, with the anterior angles much produced. Spawn of many undulating coils. *Tongue, a single plate with a large central spine and marginal denticles, and 2 separate lateral spines denticulated on the inner margin* . . . . .  
C. rufibranchialis, *Johns.*
- Gen. 35. *FAVORINUS*, *Gray.* Body slender; dorsal tentacles with a bulbous swelling; oral tentacles long; branchiæ linear, flattened, in distant transverse rows, the anterior rows double; foot narrow, with the anterior angles much produced. Spawn of many plain narrow coils. *Tongue a single plate with a single smooth spine* . . . . .  
F. albus, *A. & H.*
- Gen. 36. *PHIDIANA*, *Gray.* Body stout; dorsal tentacles clavate, laminated; oval tentacles very large; branchiæ in close, transverse rows; sides of the foot rounded. *Tongue?* . . . . .  
P. Patagonica, *D'Orb.*
- Gen. 37. *EOLIS*, *Cuv.* Body depressed, rather broad; tentacles linear, simple; branchiæ a little flattened, set in numerous close, transverse rows; foot broad, anterior angles acute. *Tongue with a single broad plate, uniformly pectinated.*  
a. Lingual spine a single arch . . . . . E. papillosa, *Linn.*  
b. Lingual spine a double arch . . . . . E. glauca, *A. & H.*
- Gen. 38. *CUTHONA*, *A.* and *H.* Body depressed; tentacles simple, linear; branchiæ clavate, in close-set rows; head much produced at the sides; foot broad, with the anterior angles rounded. *Tongue, a single plate with a large central spine and marginal denticles* . . . . .  
C. nana, *A. & H.*
- Gen. 39. *CAVOLINA*, *Cuv.* Body rather slender; tentacles linear, simple; branchiæ linear, generally in rather distant transverse rows; foot narrow, with the anterior angles rounded. Spawn slightly coiled. *Tongue, a single denticulated plate with the central spine not prominent.*  
a. Branchiæ in rather close rows . . . . . C. aurantiaca, *A. & H.*  
b. Branchiæ in rather distant rows . . . . . C. viridis, *For.*
- Gen. 40. *GALVINA*, *A.* and *H.* Body stoutish; tentacles linear, slender; oral pair short; branchiæ in rather distant rows, fusiform, inflated; foot with the anterior angles rounded. Spawn generally cup-formed. *Tongue, a central plate with large denticles and stout central spine, and 2 separate plain lateral spines.*  
a. Branchiæ much inflated . . . . . G. tricolor, *For.*  
b. Branchiæ not much inflated . . . . . G. cingulata, *A. & H.*



- Gen. 41. TERGIPES, *Cuv.* Body slender; tentacles simple, the oral pair very short; branchiæ fusiform, inflated, set in single series on each side of the back; foot narrow; anterior angles rounded. Spawn reniform. *Tongue, a single plate with a stout central spine and delicate marginal denticles* . . . TYPE.  
T. despecta, *Johns.*
- Gen. 42. EMBLETONIA, *A. and H.* Body slender; dorsal tentacles simple; oral pair flattened into 2 lateral lobes; branchiæ fusiform, set in single or double series on each side. *Tongue, a single plate bearing a central spine and lateral denticles* . . . E. pulchra, *A. & H.*

Section 2. With two posterior lateral gastro-hepatic vessels; reproductive organs with two external orifices.

Fam. 13. *Fionidæ.*

- Gen. 43. FIONA, *A. and H.* Tentacles sub-dorsal; branchial papillæ with an undulated membranous border set on a sub-pallial margin. *Tongue, a single plate with a stout central spine and marginal denticles* . . . F. nobilis, *A. & H.*

Fam. 14. *Hermæidæ.*

- Gen. 44. HERMÆA, *Lov.* Tentacles 2, dorsal, longitudinally folded; branchiæ fusiform or linear; anus in front of the heart. *Tongue, a single plate bearing a large broad spine.*
- a. Tentacles with both margins terminating at the sides of the head; body cylindrical . . . H. bifida, *Mont.*
  - b. Tentacles with the anterior margin continuous with the sides of the head, forming a sub-veil; body with the sides depressed and slightly expanded . . . H. dendritica, *A. & H.*
- Gen. 45. STILIGER, *Ehr.* (Calliopæa, D'Orb.) Tentacles 2, dorsal, simple; branchiæ fusiform, arranged in transverse rows on the sides of the back; anus in front of the heart. *Tongue, a single spine plate bearing a stout* . . . S. ornatus, *Ehr.*
- Gen. 46. ALDERIA, *Allm.* Tentacles rudimentary or none; branchiæ papillose, set in transverse rows on the sides of the back; anus postero-dorsal. *Tongue, a single plate with a large central spine* . . . A. modesta, *Lov.*

Sub-Order—PELLIBRANCHIATA.

Tribe 1. Body limaciform.

Fam. 15. *Elysiadæ.*

- Gen. 47. ELYSIA, *Risso.* Tentacles 2, longitudinally folded; lateral expansions large, plain, meeting behind and folding over the back. *Tongue, a single plate with a large central spine. A spinous buccal collar* . . . E: viridis, *Mont.*

- Gen. 48. PLACOBANCHUS, *Van Hasselt*. Tentacles 4, back with 2 lateral  
membranous expansions, having their upper surface covered  
with folds. *Tongue?* . . . . . P. ocellatus, *Rang.* TYPE.

Fam. 16. *Limapontiadæ*.

- Gen. 49. ACTEONIA, *Quatref.* Tentacles 2 flattened lobes at the sides of  
the head, produced behind into points; sides of the back with a  
tubercular ridge in the region of the anus. *Tongue, a single  
plate with a large broad spine. A spinous buccal collar* . . . A. senestra, *Quatref.*  
Gen. 50. LIMAPONTIA, *Johns.* Tentacles wanting; sides of the head arched  
and carinated; back plain, without appendages. *Tongue, a  
single plate with a large broad spine. A spinous buccal collar* L. nigra, *Johns.*

## Tribe 2. Body cylindrical or compressed.

Fam. 15. *Phyllirrhoidæ*.

- Gen. 51. PHYLLIRRHÖE, *Peron.* Tentacles 2, long; tail truncated. *Tongue,  
a single central plate with numerous denticles* . . . . . P. Bucephala, *Peron.*

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## LIST OF PLATES.

---

- Fam. 1, Pl. 1. } Anatomy of Doris.  
 2. }  
 3. Doris tuberculata.  
 4. flammea.  
 5. Johnstoni.  
 6. repanda.  
 7. coccinea.  
 8. planata.  
 9. aspera, and D. proxima.  
 10. diaphana.  
 11. bilamellata.  
 12. depressa, and D. inconspicua.  
 13. pusilla.  
 14. sparsa.  
 15. pilosa.  
 16. subquadrata, and D. oblonga.  
 17. Anatomy of Goniadoris, &c.  
 18. Goniadoris nodosa.  
 19. castanea.  
 20. Triopa claviger.  
 21. Ægirus punctilucens.  
 21 a. Thecacera pennigera.  
 22. Polycera quadrilineata.  
 23. ocellata.  
 24. Lessonii.  
 25. Ancula cristata.  
 26. Idalia aspersa.  
 27. elegans, and I. Leachii.
- Fam. 2, Pl. 1. Anatomy of Tritonia.  
 2. Tritonia Hombergii.  
 3. plebeia.  
 4. lineata.  
 5. Anatomy of Scyllæa and Lomanotus (Eumenis).
- Fam. 3, Pl. 1. Larvæ of the Eolididæ.  
 1 a. Lomanotus (Eumenis) marmorata.  
 2. Anatomy of Dendronotus.  
 3. Dendronotus arborescens.

## LIST OF PLATES.

- Fam. 3, Pl. 4. Anatomy of Doto.
5. Doto fragilis.
  6. coronata.
  7. } Anatomy of Eolis.
  8. }
  9. Eolis papillosa.
  10. Peachii, and E. Alderi.
  11. glauca.
  12. coronata.
  13. Drummondi.
  14. rufibranchialis.
  15. punctata.
  16. lineata.
  17. elegans, and E. smaragdina.
  18. gracilis.
  19. pellucida.
  20. Landsburgii.
  21. alba.
  22. stipata, and E. Glaucoides.
  23. angulata.
  24. concinna.
  25. nana.
  26. olivacea.
  27. aurantiaca.
  28. cingulata.
  29. vittata, and E. Glottensis.
  30. amœna.
  31. Northumbria, and E. arenicola.
  32. viridis.
  33. picta.
  34. tricolor.
  35. Farrani.
  36. despecta.
  37. exigua.
  38. Embletonia pulchra.
  - 38 a. Fiona nobilis.
  39. Hermæa bifida.
  40. dendritica.
  41. Alderia modesta, and Lomanotus flavidus.
  42. Proctonotus mucroniferus.
  43. Anatomy of Antiopa, &c.
  44. Antiopa cristata, and A. hyalina.

## SUPPLEMENTARY.

45. Doto pinnatifida, Eolis pustulata, and Parasites.
46. } Tongues.
47. }
48. Spicula of the Dorididæ.



## INDEX.

	PAGE			
Abstinence . . . . .	23			
Academy of Sciences, Reports of . . . . .	7, 9			
Acanthodoris . . . . .	37	<i>App.</i> xvii		
<i>Actæon</i> = <i>Elysia</i> . . . . .	37			
Acteonia . . . . .	6	<i>App.</i> xxiv		
Ægirus . . . . .	44	<i>App.</i> xix	Gen. 4, Desc.	
<i>punctilucens</i> . . . . .	44			Fam. 1, Pl. 21
<i>Æolis Lesleyana</i> = <i>Eolis papillosa</i> .				
<i>Murrayana</i> = „ „				
<i>papillosa</i> = „ „				
Alderia . . . . .	53	<i>App.</i> xxiii	Gen. 17, Desc.	Fam. 3, Pl. 43
<i>amphibia</i> = <i>modesta</i> .				
<i>modesta</i> . . . . .	53			„ Pl. 41
Alliances . . . . .	33			
Alimentary system . . . . .	11			
Allman, Prof. G. J. . . . .	37			
American species . . . . .	28			
Amphorina . . . . .	6			
<i>Amphorine</i> . . . . .	36			
Analytical table . . . . .	40			
Anatomy . . . . .	11			
Ancula . . . . .	45		Gen. 7, Desc.	
<i>cristata</i> . . . . .	45			Fam. 1, Pl. 25
Antiopa . . . . .	54		Gen. 19, Desc.	Fam. 3, Pl. 43
<i>cristata</i> . . . . .	54			„ Pl. 44
<i>hyalina</i> . . . . .	54			„ Pl. 44
<i>splendida</i> = <i>cristata</i> .				
<i>Anthrobranches</i> . . . . .	36			
Anthrobranchiata . . . . .		<i>App.</i> xiv		
Arrangement . . . . .	35			
Sketch of a general . . . . .		<i>App.</i> xiv		
Baird, Dr. W. . . . .	27			
Biological Society, Report of . . . . .	9			
Blainville, M. de . . . . .	1, 2, 36			
Blanchard, M. E. . . . .	7, 10			

	PAGE	
Bommé, M. . . . .	2	
Bomolacus . . . . .	27	
Bornella . . . . .		<i>App.</i> xx
Buccal apparatus . . . . .	11	
Calma . . . . .		<i>App.</i> xxi
Calliopæa . . . . .		<i>App.</i> xxiii
<i>dendritica</i> (Hermæa):		
Cavolina . . . . .	50	<i>App.</i> xxii
Ceratosoma . . . . .		<i>App.</i> xix
<i>Chalide</i> . . . . .	36	
Chalidis . . . . .	6	
Chromodoris . . . . .		<i>App.</i> xvii
Cilia . . . . .	16, 19	
Circulation . . . . .	15	
Classification, Rank in	35	
<i>Clælia</i> =Hero.		
Coryphella . . . . .	49	<i>App.</i> xxii
Cuthona . . . . .		<i>App.</i> xxii
Cuvier, Baron G. . . . .	2, 35	
Cyclobranchiata . . . . .	1	
Dalyell, Sir J. G. . . . .	4, 26	<i>App.</i> xiii
Degradation of types . . . . .	6	
Delle Chiaje, M. S. . . . .	4, 5, 26	
Dendronotinæ . . . . .	47	
Dendronotus . . . . .	47	Gen. 11, Desc. Fam. 3, Pl. 2
<i>arborescens</i> . . . . .	47	„ Pl. 3
Description, General . . . . .	1	
<i>Dermobranches</i> . . . . .	36	
Development . . . . .	25	Gen. 1 (Doris), Desc.
Distribution . . . . .	27	
Table of, Geographical . . . . .	31	
„ in zones of depth . . . . .	32	
<i>Diceres</i> . . . . .	36	
Diphyllidia . . . . .		<i>App.</i> xx
D'Orbigny, M. Alc. . . . .	4, 36	
Dorididæ . . . . .	41	
Doridinæ . . . . .	41	
Doris . . . . .	41	Gen. 1, Desc. Fam. 1, Pl. 1, 2
<i>affinis</i> =bilamellata.		
<i>arborescens</i> (Dendronotus).		
<i>argo</i> , Penn.=tuberculata.		
<i>aspera</i> . . . . .	42	Fam. 1, Pl. 9
<i>Barvicensis</i> (Goniodoris).		
<i>bifida</i> (Hermæa).		
bilamellata . . . . .	43	Fam. 1, Pl. 11

# INDEX.

xxxiii

	PAGE	
<i>Doris Bodoensis</i> = <i>Eolis papillosa</i> .		
<i>Britannica</i> = <i>tuberculata</i> .		
<i>cærulea</i> ( <i>Eolis</i> ).		
<i>cervina</i> = <i>Dendronotus arborescens</i> .		
<i>clavigera</i> ( <i>Triopa</i> ).		
<i>coccinea</i> . . . . .	42	Fam. 1, Pl. 7
<i>cornuta</i> = <i>Polycera quadrilineata</i> .		
<i>coronata</i> ( <i>Doto</i> ).		
<i>depressa</i> . . . . .	43	Fam. 1, Pl. 12
<i>diaphana</i> . . . . .	42	„ Pl. 10
<i>Elfortiana</i> = <i>bilamellata</i> .		
<i>flammea</i> . . . . .	41	„ Pl. 4
<i>flava</i> = <i>Polycera quadrilineata</i> .		
<i>Flemingii</i> = <i>pilosa</i> .		
<i>frondosa</i> = <i>Tritonia Hombergii</i> (?).		
<i>fusca</i> = <i>pilosa</i> .		
<i>illuminata</i> = <i>Polycera Lessonii</i> .		
<i>inconspicua</i> . . . . .	43	Fam. 1, Pl. 12
<i>Johnstoni</i> . . . . .	42	„ Pl. 5
<i>Leachii</i> = <i>bilamellata</i> .		
<i>lævis</i> , <i>Flem.</i> = <i>repanda</i> .		
<i>liturata</i> = <i>bilamellata</i> .		
<i>longicornis</i> = <i>Eolis coronata</i> (?)		<i>App.</i> vii
<i>maculosa</i> = <i>Doto coronata</i> (?)		
<i>marginata</i> = <i>Goniodoris nodosa</i> .		
<i>Maura</i> = <i>Ægirus punctilucens</i> .		
<i>mera</i> = <i>tuberculata</i> .		
<i>millegrana</i> . . . . .	42	<i>App.</i> i
<i>nigricans</i> = <i>pilosa</i> .		
<i>nodosa</i> ( <i>Goniodoris</i> ).		
<i>oblonga</i> . . . . .	43	Fam. 1, Pl. 16
<i>obvelata</i> , <i>Johns.</i> = <i>Johnstoni</i> .		
<i>obvelata</i> , <i>Lovén</i> = <i>repanda</i> .		
<i>papillosa</i> ( <i>Eolis</i> ).		
<i>pedata</i> = <i>Eolis Landsburgii</i> (?)		<i>App.</i> viii
<i>pilosa</i> . . . . .	43	Fam. 1, Pl. 15
<i>pinnatifida</i> ( <i>Doto</i> ).		
<i>planata</i> . . . . .	42	„ Pl. 8
<i>proxima</i> . . . . .	42	„ Pl. 9
<i>pseudo-argus</i> = <i>tuberculata</i> .		
<i>pusilla</i> . . . . .	43	<i>App.</i> iii „ Pl. 13
<i>quadricornis</i> ( <i>Idalia</i> ).		
<i>quadrilineata</i> ( <i>Polycera</i> ).		
<i>repanda</i> . . . . .	42	<i>App.</i> ii Fam. 1, Pl. 6
<i>similis</i> = <i>pilosa</i> .		
<i>sparsa</i> . . . . .	43	„ Pl. 14
<i>stellata</i> = <i>pilosa</i> .		

	PAGE			
<i>Doris sublevis</i> = <i>pilosa</i> .				
subquadrata . . . . .	43	<i>App.</i> iii . . . . .	Fam. 1, Pl. 16	
tuberculata . . . . .	41	. . . . .	„ Pl. 3	
Ulidiana . . . . .	42	<i>App.</i> ii . . . . .		
<i>vermiger</i> a= <i>Eolis papillosa</i> .				
<i>verrucosa</i> = <i>bilamellata</i> .				
<i>vulgaris</i> = <i>bilamellata</i> .				
Zetlandica . . . . .	42	<i>App.</i> i . . . . .		
Doto . . . . .	48	<i>App.</i> xxi Gen. 12, Desc.	Fam. 3, Pl. 4	
coronata . . . . .	48	. . . . .	„ Pl. 6	
fragilis . . . . .	48	. . . . .	„ Pl. 5	
pinnatifida . . . . .	48	. . . . .	„ Pl. 45	
Edwards, M. Milne . . . . .	5, 7, 8, 10			
Elysia . . . . .	38	<i>App.</i> xxiii . . . . .		
Embleton, Dr. D. . . . .	8, 10			
Embletonia . . . . .	52	<i>App.</i> xxiii Gen. 14, Desc.	Fam. 3, Pl. 38	
minuta . . . . .	52	<i>App.</i> xii . . . . .		
pallida . . . . .	52	<i>App.</i> xii . . . . .		
pulchra . . . . .	52	. . . . .	Fam. 3, Pl. 38	
<i>Enterobranches</i> . . . . .	36			
<i>Eolida coronata</i> (Eolis).				
<i>minuta</i> (Embletonia).				
<i>papillosa</i> (Eolis).				
<i>purpurascens</i> (Eolis).				
Zetlandica= <i>Eolis papillosa</i> .				
<i>Eolidia Cuvieri</i> , Leach= <i>Eolis papillosa</i> .				
<i>Cuvieri</i> , Johns.= <i>Eolis carnea</i> (?).				
<i>Embletoni</i> = <i>rufibranchialis</i> (?).				
<i>papillosa</i> (Eolis).				
<i>rufibranchialis</i> (Eolis).				
Eolididæ . . . . .	47			
Larvæ of . . . . .		. . . . .	Fam. 3, Pl. 1	
Eolidina paradoxum . . . . .	5			
Eolidinæ . . . . .	48			
Eolis . . . . .	48	<i>App.</i> xxii Gen. 13, Desc.	Fam. 3, Pl. 7, 8	
alba . . . . .	49	<i>App.</i> viii . . . . .	„ Pl. 21	
Alderi . . . . .	48	. . . . .	„ Pl. 10	
angulata . . . . .	50	. . . . .	„ Pl. 23	
amethystina . . . . .	52	<i>App.</i> xi . . . . .		
amœna . . . . .	51	<i>App.</i> x . . . . .	„ Pl. 30	
arenicola . . . . .	51	. . . . .	„ Pl. 31	
aurantiaca . . . . .	51	. . . . .	„ Pl. 27	
<i>bellula</i> = <i>aurantiaca</i> (?).				
cærulea . . . . .	51	<i>App.</i> xi . . . . .		
carnea . . . . .	50	<i>App.</i> ix . . . . .		
cingulata . . . . .	51	. . . . .	Fam. 3, Pl. 28	

# INDEX.

XXXV

	PAGE		
Eolis concinna . . .	50		Fam. 3, Pl. 24
coronata . . .	49	App. vii	
Couchii . . .	51	App. x	
<i>cristata</i> (Antiopa).			
<i>curta</i> =Drummondi.			
<i>Cuvieri</i> , Lam.=papillosa.			
despecta . . .	52	App. xii	Fam. 3, Pl. 36
Drummondi . . .	49	App. viii	„ Pl. 13
elegans . . .	49		„ Pl. 17
exigua . . .	52	App. xii	„ Pl. 37
Farrani . . .	52	App. xi	„ Pl. 35
glaucia . . .	48	App. vii	„ Pl. 11
Glaucoides . . .	50		„ Pl. 22
Glottensis . . .	51		„ Pl. 29
gracilis . . .	49		„ Pl. 18
<i>hystrix</i> , A. & H.=cingulata.			
inornata . . .	50	App. ix	
Landsburgii . . .	49	App. viii	„ Pl. 20
lineata . . .	49		„ Pl. 16
nana . . .	50		„ Pl. 25
Northumbria . . .	51		„ Pl. 31
<i>obtusalis</i> =papillosa.			
olivacea . . .	50	App. x	„ Pl. 26
<i>pallida</i> =picta.			
papillosa . . .	48		„ Pl. 9
Peachii . . .	50		„ Pl. 10
pellucida . . .	49		„ Pl. 19
picta . . .	51		„ Pl. 33
punctata . . .	49		„ Pl. 15
purpurascens . . .	51	App. xi	
pustulata . . .	51		„ Pl. 45
<i>rosea</i> =papillosa.			
rufibranchialis . . .	49		„ Pl. 14
smaragdina . . .	49		„ Pl. 17
stipata . . .	50		„ Pl. 22
<i>tenuibranchialis</i> =Drummondi.			
tricolor . . .	52		„ Pl. 34
viridis . . .	51		„ Pl. 32
vittata . . .	51		„ Pl. 29
<i>violacea</i> =tricolor.			
Ergasilus . . .	27		
<i>Eubbranchus tricolor</i> (Eolis).			
Eumenis (Lomanotus) . . .		Gen. 10, Desc.	Fam. 2, Pl. 5
marmorata . . .			Fam. 3, Pl. 1a
Euplocamus . . .		App. xix	
<i>claviger</i> (Triopa).			
<i>plumosus</i> =Triopa claviger.			

	PAGE			
Eyes . . . . .	19			
Fabricius, O. . . . .	2			
Facelina . . . . .		App. xxii		
Favorinus . . . . .		App. xxii		
Fiona . . . . .	52	App. xxiii	Gen. 15, Desc.	Fam. 3, Pl. 38a
nobilis . . . . .	53			
Flabellina . . . . .	48	App. xxi		
Fleming, Rev. Dr. . . . .	4			
Ferussac, Baron de . . . . .	35, 36			
Floating . . . . .	21			
Food . . . . .	23			
Forbes, Prof. E. . . . .	4			
Fryeria . . . . .	38	App. xix		
Galvina . . . . .		App. xxii		
Ganglia . . . . .	16			
Gastro-biliary system . . . . .	8			
Gastro-hepatic system . . . . .	13			
Gastro-vascular system . . . . .	5			
Generation, Organs of . . . . .	14			
Glaucus . . . . .		App. xxi		
Goniodoris . . . . .	43	App. xviii	Gen. 2, Desc.	Fam. 1, Pl. 17
<i>Barvicensis</i> =nodosa.				
<i>castanea</i> . . . . .	44			Pl. 19.
<i>elongata</i> =nodosa.				
<i>emarginata</i> =nodosa.				
<i>nodosa</i> . . . . .	44			Fam. 1, Pl. 18
Gray, Dr. J. E. . . . .	3, 33, 37, 39			
<i>Gymnobranchiata</i> =Nudibranchiata.				
Habits . . . . .	20			
Hermaphroditism . . . . .	14, 25			
Hermæa . . . . .	53	App. xii	Gen. 16, Desc.	
<i>bifida</i> . . . . .	53			Fam. 3, Pl. 39
<i>dendritica</i> . . . . .	53			Pl. 40
Hero . . . . .		App. xx		
Hexabanchus . . . . .		App. xvii		
History . . . . .	2			
Idalia . . . . .	45	App. xviii	Gen. 8, Desc.	Fam. 1, Pl. 17
<i>aspersa</i> . . . . .	46	App. iv		Pl. 26
<i>cirrigera</i> , Lov.= <i>aspersa</i> .				
<i>cristata</i> (Ancula).				
<i>elegans</i> . . . . .	46			Fam. 1, Pl. 27
<i>inæqualis</i> . . . . .	46	App. v		
<i>lacunosa</i> = <i>elegans</i> .				

# INDEX.

xxxvii

	PAGE	
Idalia Leachii . . . . .	46	Fam. 1, Pl. 27
pulchella . . . . .	46	App. v
quadricornis . . . . .	46	App. v
<i>Janus Spinolæ</i> = <i>Antiopa cristata</i> .		
Jaws . . . . .	11	
Johnston, Dr. G. . . . .	4, 20	
Lacunes . . . . .	6, 9, 10	
Lamarck, M. de . . . . .	2, 35	
Lamellidoris . . . . .	42	App. xvii
Larvæ . . . . .	5, 25	Gen. 1 (Doris), Desc.
of the Eolididæ . . . . .		Fam. 3, Pl. 1
Leach, Dr. W. E. . . . .	3	
Lerneidæ . . . . .	26	
Limapontia . . . . .		App. xxiv
Linnaeus, C. . . . .	2	
Lomanotus . . . . .	47	App. vii Gen. 10, Desc. Fam. 2, Pl. 5
flavidus . . . . .	47	Fam. 3, Pl. 41
marmoratus . . . . .	47	„ Pl. 1a
Longevity . . . . .	24	
Lovén, Prof. S. . . . .	4, 5	
Lowe, Rev. R. T. . . . .	22	
Mediterranean species . . . . .	28	
<i>Melibæa coronata</i> (Doto).		
<i>fragilis</i> (Doto).		
<i>ornata</i> = <i>Doto coronata</i> .		
<i>pinnatifida</i> , Johns.= <i>Doto fragilis</i> .		
Melibe . . . . .		App. xxi
Melibinæ . . . . .	48	
Metamorphosis . . . . .	5, 25	
Migration (?) . . . . .	23	
Monstrosities . . . . .	26	
Montagu, G. . . . .	3	
<i>Montagua cærulea</i> (Eolis).		
<i>viridis</i> (Eolis).		
Mucus-gland . . . . .	14	
Muller, O. F. . . . .	2	
Nervous system . . . . .	16	
Nordmann, Prof. A. de . . . . .	10, 25	
Number of species . . . . .	30	
Esophagus . . . . .	12	
<i>Oithona nobilis</i> (Fiona).		
Olfactory organs . . . . .	6, 19	

	PAGE		
Onchidium . . .	34		
Onchidoridæ . . .	37		
Onchidoris . . .	37		
Opisthobranches . . .	10		
Opisthobranchiata . . .	1		
Organs of hearing . . .	6, 19		
Organs of smell . . .	6, 19		
Otolithes . . .	19		
Ova . . .	25		
Ovarium . . .	14		
Ovate vesicles . . .	6, 13		
Parasites . . .	26		
<i>Pavois</i> . . .	36		
<i>Pelagella</i> = <i>Goniodoris</i> .			
Pelta . . .	6		
Pennant, T. . .	3		
Peplidia . . .	22		
Periodical appearance . . .	23		
Phidiana . . .		<i>App.</i> xxii	
Phlebenterata . . .	6, 36		
Phlebenterism . . .	6		
Phosphorescence . . .	22		
Phyllidia . . .	38	<i>App.</i> xix	
Phyllirrhoë . . .	38	<i>App.</i> xxiv	
Placobranchus . . .		<i>App.</i> xxiv	
Placomopherus . . .		<i>App.</i> xix	
<i>Polybranches</i> . . .	36		
<i>Polybranchiata</i> . . .	1	<i>App.</i> xiv	
Polycera . . .	45		Gen. 6, Desc. Fam. 1, Pl. 17
<i>citrina</i> = <i>Lessonii</i> .			
<i>cornuta</i> = <i>quadrilineata</i> .			
<i>cristata</i> ( <i>Ancula</i> ).			
<i>flava</i> = <i>quadrilineata</i> .			
<i>Lessonii</i> . . .	45		Fam. 1, Pl. 24
<i>lineata</i> = <i>quadrilineata</i> .			
<i>modesta</i> = <i>Lessonii</i> .			
<i>ocellata</i> . . .	45		„ Pl. 23
<i>quadrilineata</i> . . .	45		„ Pl. 22
<i>typica</i> = <i>quadrilineata</i> .			
Polycerinae . . .	43		
Portal heart . . .	10, 15		
Prehensile collar . . .	12		
Proctonotus . . .	53		Gen. 18, Desc. Fam. 3, Pl. 43
<i>mucroniferus</i> . . .	53		„ „ Pl. 42
Progression . . .	20		
<i>Pterochilus pulcher</i> = <i>Embletonia pulchra</i> .			



# INDEX.

xxxix

	PAGE	
Pulsations of the heart . . . . .	16	
Quatrefages, M. de . . . . .	5, 20, 34, 36	
Rang, M. Sander . . . . .	21	
Regions, Geographical . . . . .	29	
Reid, Dr. John . . . . .	10	
Renal organ . . . . .	16	
Reproduction of lost parts . . . . .	22	
Reproductive organs . . . . .	14	
Respiration . . . . .	15	
Robin, Dr. C. . . . .	9	
Sars, M. . . . .	5	
Scyllæa . . . . .	47	App. xx Gen. 9 bis, Desc. Fam. 2, Pl. 5
pelagica . . . . .	47	App. vi
<i>punctata</i> = <i>Doto coronata</i> .		
Senses . . . . .	19	
Sinuses . . . . .	15	
Souleyet, M. . . . .	8, 33	
Spawn . . . . .	25	
<i>Sphærostoma Jamesoni</i> = <i>Tritonia Hombergii</i> .		
Spicula . . . . .	19	Pl. 48, Supplementary.
Stiliger . . . . .		App. xxiii
<i>modestus</i> (Alderia).		
Swimming . . . . .	21	
Sympathetic system . . . . .	16, 18	
Synopsis . . . . .	41	
Tenacity of life . . . . .	23	
Tergipes . . . . .	52	App. xxiii
<i>coronata</i> (Doto).		
<i>lacinulata</i> , Lov.= <i>Eolis exigua</i> .		
<i>Tetraceres</i> . . . . .	36	
Thecacera . . . . .	44	Gen. 5, Desc.
<i>cāpitata</i> . . . . .	44	App. iv
<i>pennigera</i> . . . . .	44	App. iii Fam. 1, Pl. 21 a
<i>virescens</i> . . . . .	44	App. iv
Thompson, W. . . . .	4	
Tongue . . . . .	11	Pl. 46, 47, Sup.
Triopa . . . . .	44	Gen. 3, Desc.
<i>claviger</i> . . . . .	44	Fam. 1, Pl. 20
Triopidæ . . . . .	37	
Tritonia . . . . .	46	Gen. 9, Desc. Fam. 2, Pl. 1
<i>alba</i> . . . . .	46	App. vi
<i>arborescens</i> ( <i>Dendronotus</i> ).		
<i>atropurpurea</i> = <i>Hombergii</i> .		
<i>bifida</i> ( <i>Hermæa</i> ).		

	PAGE	
<i>Tritonia felina</i> = <i>Dendronotus arborescens</i> .		
<i>Hombergii</i> . . . . .	46	Fam. 2, Pl. 2
<i>lactea</i> = <i>Dendronotus arborescens</i> .		
<i>lineata</i> . . . . .	47	„ Pl. 4
<i>pinnatifida</i> (Doto).		
<i>plebeia</i> . . . . .	47	„ Pl. 3
<i>pulchella</i> = <i>Dendronotus arborescens</i> .		
<i>pulchra</i> = <i>plebeia</i> .		
<i>Reynoldsii</i> = <i>Dendronotus arborescens</i> .		
<i>Tritoniadæ</i> . . . . .	46	
<i>Tritoniens</i> . . . . .	35	
Turton, Dr. W. . . . .	3	
Urticating apparatus . . . . .	6, 13, 22	
Veins . . . . .	15	
<i>Venilia mucronifera</i> (Proctonotus).		
Verany, Prof. G. B. . . . .	5, 28	
Voracity . . . . .	23	
Voyage to Sicily . . . . .	7	
Zephyrina . . . . .	6, 36	
Zones of depth . . . . .	32	

# ERRATA.

- History, &c., p. 36, l. 9, *for* "Tetracres," *read* "Tetraceres."
- p. 49, l. 20, *for* "13," *read* "14."
- p. 51, l. 8, *for* "46," *read* "45."
- Fam. 1, Pl. 1, Gen. Doris, p. 8, l. 5, *for* "brancho-cardiac," *read* "branchio-cardiac."
- p. 12, l. 2, *for* "a shell closely investing," *read* "a shell is then perceived closely investing."
- Pl. 17, Gen. Goniodoris, p. 3, l. 30, *for* "larger," *read* "large."
- Gen. Idalia, p. 2, l. 15, *for* "fig. 5a," *read* "Pl. 17, fig. 5a."
- p. 2, l. 28, *for* "anterior surface," *read* "anterior portion."
- Pl. 21, *for* "Ægires," *read* "Ægirus."
- Fam. 3, Pl. 2, Gen. Dendronotus, p. 1, l. 3, *for* "altus," *read* "altius."
- p. 2, l. 30, *for* "lies above the ovarium and not below," *read* "lies below the ovarium and not above."
- Pl. 3, Dendronotus arborescens, p. 1, l. 12, "Fide Gould," should be on the line above.
- Pl. 4, Gen. Doto, p. 2, last line, *for* "digestive," *read* "vascular."
- p. 4, l. 19, Generative Organs. *Add*—"a, male intromittent organ partially exerted; b, female orifice; c, testacle; d, ovary; e, oviduct; f, dilated portion of the same; g, g, mucus-gland; h, spermatheca."
- Pl. 7, 8, Gen. Eolis, p. 3, l. 16, *for* "epitomy," *read* "epitome."
- p. 6, l. 32, *dele* "and sides of the back."
- p. 7, l. 3, *for* "fig. 3b," *read* "fig. 3l."
- p. 9, l. 13, *for* "skin on the side of the back," *read* "skin on the foot."
- Pl. 12, Eolis coronata, p. 2, l. 25, *for* "Whitby," *read* "Whitley."
- Pl. 38a, Gen. Fiona, p. 2, l. 17, *for* "9," *read* "7."
- p. 2, l. 29, *for* "4, 6," *read* "4b."
- p. 3, l. 9, *for* "(l)" *read* "(i)."
- p. 4, l. 9, *for* "2a," *read* "2c."
- Appendix, p. xiv, l. 6, *for* "Acanthobranchiata," *read* "Anthrobranchiata."
- p. xv, l. 13, *for* "Bornellia," *read* "Bornella."
- p. xvi, l. 19, *for* "Acanthobranchiata," *read* "Anthrobranchiata."

#### DIRECTIONS TO THE BINDER.

In binding this Monograph into one volume the following arrangement must be preserved :

Preface.

Contents of Parts.

History, &c. (paged.)

Plates, with their descriptions.

The descriptions of Genera, where not connected with a plate, are to be placed according to their *Number*,  
and before the plates of species belonging to the genus.

Appendix.

List of Works quoted.

Index.

Errata.

The Advertisement and First or Provisional Synopsis must be cancelled.

















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